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The Coast Guard knowledge base: building online communities, teams and experts to facilitate rapid creation, capture and sharing of service related knowledge

Sorenson, Andrew J.

NAVAL POSTGRADUATE SCHOOL
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THESIS

THE COAST GUARD KNOWLEDGE BASE: BUILDING ONLINE COMMUNITIES, TEAMS AND EXPERTS TO FACILITATE RAPID CREATION, CAPTURE AND SHARING OF SERVICE RELATED KNOWLEDGE

by

Andrew J. Sorenson

June 2001

Thesis Advisor:	Dr. Mark E. Nissen
Associate Advisor:	Dr. Roger D. Evered

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The U.S. Coast Guard is reaching the limits of incrementalism. Extending aircraft and cutter service-lives, increasing work hours to compensate for reduced manpower, responding to data calls faster and squeezing another penny out of costsare the challenges of leaders today. But pursuing incremental improvements is similar to paving over cow paths. Today's technology provides the Coast Guard with the opportunity to make exponential improvements in processes for managing knowledge, and to revolutionize business practices.This thesis presents a knowledge management architecture that addresses articulable limits to fast, efficient, knowledge management within the cutter community. Building upon a foundation of messaging and collaboration, the architecture provides modules maximizing the ability to manage informal and formal knowledge. The results are a transparent interface for the creation, sharing and capture of organizational knowledge. Successful implementation is dependent upon the improvement of the Coast Guard's IT infrastructure and the creation of a culture friendly to knowledge sharing.

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THE COAST GUARD KNOWLEDGE BASE: BUILDING ONLINE COMMUNITIES, TEAMS, AND EXPERTS TO FACILITATE RAPID CREATION, CAPTURE AND SHARING OF SERVICE RELATED KNOWLEDGE

Andrew J. Sorenson
Lieutenant Commander, United States Coast Guard
B.S., U.S. Coast Guard Academy, 1988

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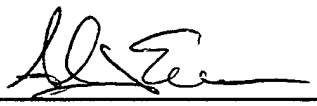
Author: 
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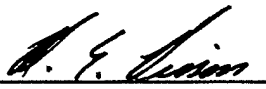
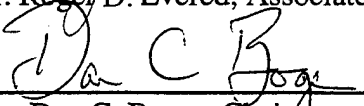
Approved by: 
Dr. Mark E. Nissen, Thesis Advisor


Dr. Roger D. Evered, Associate Advisor


Dan C. Boger, Chairman
Information Systems Academic Group

ABSTRACT

The U.S. Coast Guard is reaching the limits of incrementalism. Extending aircraft and cutter service-lives, increasing work hours to compensate for reduced manpower, responding to data calls faster and squeezing another penny out of costs are the challenges of leaders today. But pursuing incremental improvements is similar to paving over cow paths. Today's technology provides the Coast Guard with the opportunity to make exponential improvements in processes for managing knowledge, and to revolutionize business practices.

This thesis presents a knowledge management architecture that addresses articulable limits to fast, efficient, knowledge management within the cutter community. Building upon a foundation of messaging and collaboration, the architecture provides modules maximizing the ability to manage informal and formal knowledge. The results are a transparent interface for the creation, sharing and capture of organizational knowledge. Successful implementation is dependent upon the improvement of the Coast Guard's IT infrastructure and the creation of a culture friendly to knowledge sharing.

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I. INTRODUCTION

A. BACKGROUND

The newly independent United States of America faced a new problem in 1789 born of decades of long resistance to British laws and tariffs – smuggling. Congress, in April and May of that year, while debating the establishment of its own customs duties, realized that the United States required the ability to enforce its laws and prevent smuggling on the high seas and coastal waters of its Atlantic coast. Alexander Hamilton, Secretary of the Treasury, sought a solution to this problem as evidenced by his actions:

> Fully aware of the difficulties he faced, Hamilton sent out two Treasury Department circulars, dated 2 October 1789 and 23 September 1790, asking collectors whether there was smuggling in their districts and if they needed boats to secure revenue. In reply, the collectors variously explained that smuggling, which had been rampant under state control, continued unabated under federal regulations. Sharp Delany, the collector at Philadelphia, then the busiest port in the nation, was forceful in advocating the employment of boats in inspections and deserves much of the credit for convincing Hamilton of the need for them. (King, 1989)

Based on the collectors' knowledge and experiences, Hamilton was able to present Congress with a bill calling for the establishment of the U.S. Revenue Cutter service in 1790. Congress approved this bill 4 August 1790, thereby establishing the precursor of today's U.S. Coast Guard. Hamilton continued to expand the Coast Guard and the nation's body of ship building knowledge by intentionally seeking to create a ship building industry within the United States rather than relying on foreign powers. While

not economically justifiable, this strategy contributed to the success of the Revenue Cutter Service, and prepared the nation for the creation of the U.S. Navy eight years later.

Hamilton successfully used and oversaw the creation of knowledge to achieve his political and national agendas. This example illustrates the power of properly applied knowledge, which is one of the reasons for the recent explosion of interest regarding the topic of knowledge management. Organization and management theorists have documented other advantages and popularized the notion of knowledge as an asset. Treating knowledge as an asset means that it must be efficiently and effectively managed to gain the most advantage for the corporation (Zack, 1999). Not only is effective use of knowledge important for corporations, but also as shown by Hamilton, it's critical for government agencies, such as the Coast Guard, which thrive on knowledge.

The Coast Guard, after identifying gaps in the way information and knowledge were handled within the organization, has begun to formalize its knowledge management efforts. The passage of the Government Performance and Results Act (GRPA) of 1993 and the Clinger-Cohen Act, led the Coast Guard to formally recognize the need for a Chief Information Officer and an Information Technology Strategy. Yet it was not until July 2000 that the Coast Guard formally established the position of Chief Knowledge Officer and began restructuring its headquarters staff to accommodate this new entity. This reorganization, a result of the recognition of knowledge as a valuable asset, now stands to benefit from the formal body of knowledge being developed.

B. PURPOSE

The Revenue Cutter Service began in 1790 with ten ships and 40 officers. The Coast Guard today has grown to include over 30,000 men and women, over 1,400 boats, 245 cutters, and 211 aircraft. Coast Guard personnel and units are deployed worldwide, and have served in every major military conflict fought by the United States. The Coast Guard has a great diversity of personnel, equipment, missions, and worldwide deployments that necessitate timely sharing of information and knowledge.

The complexity of modern Coast Guard operations and equipment requires a broad base of knowledge and training for all personnel. Coast Guard Officers have always had to be proficient at seamanship, navigation, and leadership. Today, however, they must also master complex fire control systems, communication platforms, radars, electronic navigation tools, complex engineering plants, and a myriad of laws, treaties, bilateral agreements, and operational plans. Today's Coastguardsmen face an enormous challenge to learn the systems and practices for efficient performance of their duties.

The Coast Guard has attempted to help its members meet this challenge by developing methods for sharing knowledge across the organization and within its distinct communities (e.g., Aviation, Marine Safety). These methods exist both formally (e.g., Lessons Learned, After Action Reports, schools, training teams, meetings, newsletters, and other formal publications) and informally (e.g., email, phone calls, water-cooler discussions, personnel transfers). Each of these methods possesses strengths and weaknesses, but as a whole, are maintained independent of each other. These tools, in

many cases, fail to successfully capture or use much of the information and knowledge stored inside the minds of Coastguardsmen, or to connect users of the information with resources outside the local community or method being used. The Coast Guard must seek to improve or replace these methods, and take advantage of technology to improve the speed, reliability, and accuracy of knowledge capture and reuse.

Traditional methods of knowledge and information transfer have served to limit the speed of development for new ideas and concepts. Top companies and organizations now realize that senior managers and leaders do not have a monopoly on imagination and good ideas, yet new ideas must ultimately be understood and endorsed by the top to succeed (Hamel, 1996). Senior Coast Guard leaders, by facilitating the rapid development and communication of these ideas both horizontally and vertically throughout the Coast Guard, can not only enhance their awareness of these ideas, but also disseminate concepts, visions, and plans directly on a personal level. This rapid dissemination assists in achieving earlier buy-in and implementation of the most successful ideas and knowledge.

Enhancement of knowledge sharing between communities, fostering development of new ideas, rapid dissemination of course changes, and collaborative visioning throughout the work force can lead to a faster, more efficient organization. This may allow people increased opportunity to express concepts and ideas, and achieve personal satisfaction within the organization. Effective and efficient use of these ideas and

communications capabilities by the Coast Guard gives further proof to the slogan, "Our people are our most valuable asset."

Finally, any revolutionary application of technology, or new way of managing knowledge fails to achieve its full measure of success without a thorough understanding of cultural barriers and resistance to proposed changes. By identifying these obstacles, steps can be taken to overcome and minimize them to ensure maximum opportunity for acceptance and success of the processes.

C. RESEARCH QUESTIONS

The primary research question is: "How can organizational and technological interventions from knowledge management be employed to innovate processes performed in the Coast Guard High and Medium Endurance Cutter Community?" The subsidiary research questions are:

- What mission, environment, and processes are associated with the High Endurance Cutter/Medium Endurance Cutter (HEC/MEC) community?
- What problems or shortcomings currently afflict the HEC/MEC processes?
- What is knowledge management, and how can it be applied to HEC/MEC processes?
- How can HEC/MEC processes be redesigned to reflect innovation through knowledge management?
- How should the USCG best manage change to implement its process innovation?
- How can the results of this research be generalized to other organizations and processes?

D. SCOPE AND METHODOLOGY

The scope of this research focuses on the existing knowledge within the Coast Guard, how to capture that knowledge, and facilitate its sharing. Cultural barriers to sharing knowledge, transferring ideas, and implementing technology solutions are also examined. Finally, a review of existing IT solutions, and those under development is conducted. The research, while applicable for all Coast Guard communities, for simplicity, focuses on the High and Medium Endurance Cutter (HEC/MEC) community.

E. ORGANIZATION OF STUDY

This thesis is organized as follows. Chapter II follows the introduction and gives an overview of knowledge management, change management, and the HEC/MEC community. Chapter III outlines the current knowledge management practices within the HEC/MEC community. Chapter IV contains the HEC/MEC community Knowledge Management architectural design. Chapter V follows with conclusions and recommendations.

II. KNOWLEDGE MANAGEMENT AND THE CUTTER COMMUNITY

A. KNOWLEDGE MANAGEMENT

1. Rationale for Knowledge Management

The business press is awash in articles popularizing the notion of knowledge as a corporate strategic asset, and theories on how to manage it efficiently and effectively. Corporations have added Chief Knowledge Officers to improve their competitiveness and drive down costs through the efficient use of existing knowledge. Meanwhile technology firms compete to sell the latest solutions to managing knowledge in ways that will allow businesses to capture, store, and use their knowledge faster than their competitors, exploiting opportunities and gaining market share. What is responsible for this interest in knowledge management?

There are many reasons businesses are sharpening their focus on knowledge. One, the shift away from an industrial economy to a service economy, or the information economy, has led firms to begin documenting what they know. A second factor, the globalization of the economy has led to greater competitiveness in all aspects of corporate operations, leading firms to seek any foreseeable advantage. Finally, the trend toward leaner organizations contributes to this interest, by motivating firms to avoid losing irreplaceable knowledge in the process of downsizing or normal attrition (Davenport, 1998).

Many companies seeking to embrace knowledge management are finding it difficult. Increasing organizational size, complexity, and geographic dispersion, increases the difficulty of developing and leveraging knowledge assets. Today's rapid pace of technological change threatens to obsolesce knowledge before it can be documented and used. Many firms are also encountering personal barriers, to the sharing and use of knowledge, which can effectively end a knowledge management initiative. Despite the many obstacles, the value of knowledge management outweighs the costs of developing effective solutions and is driving corporations, governments, and the U.S. Coast Guard toward knowledge management solutions.

The Coast Guard has long recognized the need for qualified, knowledgeable personnel to serve as officers and man its ships. As Alexander Hamilton stated (qtd by King p. 30, 1989).

> While I recommend in the strongest terms to the respective Officers activity, vigilance & firmness, I feel no less solicitude that their deportment may be marked with prudence, moderation & good temper... They will endeavor to overcome difficulties, if any are experienced, by a cool and temperate perseverance in their duty, by address & moderation rather than by vehemence or violence.

Early Revenue Cutter officers were expected to be innovative and resourceful in solving delicate problems and executing their duties. Modern Coastguardsmen face an even greater challenge in keeping up with the wide variety of equipment, laws, and technical issues, and must be no less resourceful. Collaboration is necessary, amongst the many officers deployed on cutters performing similar missions, in order to resolve

common issues for the sake of expedience and uniformity of practice. Resolving these issues necessitates a knowledge management approach for the Coast Guard.

Knowledge management can help the Coast Guard not only to capture solutions to problems and best practices, but also help new officers and crewmembers reporting to cutters decrease the time required to learn their jobs and become effective. Crewmembers gain enormous amounts of knowledge during the course of their tours. Most of this knowledge departs with them at the end of their tour, leaving their successor to learn many of the same lessons. Meanwhile, down the pier, other personnel are working to solve the same problems and learn the same skills. Atlantic and Pacific Area Commanders' staffs work to coordinate efforts, as do personnel at Coast Guard Headquarters, yet every day there are countless Coastguardsmen working alone, or in small groups, to tackle similar issues and tasks. An organization such as the Coast Guard must focus its resources and capabilities to leverage its knowledge, by developing an architecture for its management (Zack, 1999).

2. What is Knowledge?

The body of research available on knowledge and knowledge management contains assorted definitions and labels for knowledge. Before examining the various types of knowledge, it is necessary to define knowledge, information, and data, as the terms are applied to knowledge management.

The dictionary defines data as "factual information (as measurements or statistics) used as a basis for reasoning, discussion, or calculation" (Webster's, 1984). Davenport

and Prusak (1998) are even more concise in stating, "Data is a set of discrete, objective facts about events." Whichever definition is used, data comprises the core facts stripped down to raw numbers, or statements, stripped of their context and meaning. A credit card number by itself is simply a piece of data, not very valuable, and, for the most part, unrecognizable. However, the same number, when combined with other data such as a name, and expiration date, suddenly becomes valuable, and is guarded by banks and consumers.

The credit card number, when shown in context, or combined with other data, is transformed into information. As Davenport and Prusak (1998) state, "Information is data endowed with relevance and purpose." It's meant to change the way the receiver perceives something and to have an impact on his judgment and behavior. Data mining has become popular as corporations attempt to find meaning and relevance in the data accumulated in their databases – to create information. This information can be used to spot trends, analyze business decisions, or to measure the effectiveness of programs. Companies, in order to get the most use out of data mining, must find a way to apply reasoning, experience, and judgment to the information to facilitate decision-making. This is where knowledge comes into the equation.

Turning again to the dictionary, knowledge is defined as "the fact or condition of knowing something with familiarity gained through experience or association" (Webster's, 1984). Zack (1999) agrees that knowledge is our set of beliefs and values stemming from a meaningfully organized accumulation of information through

experience, communication, or inference. Knowledge is more than just a collection of information or data. Knowledge flows from the sum of one's experiences, values, and beliefs based upon the context in which they were presented and understood. Knowledge is the ability to turn information and data into effective action (Applehans, et al., 1999). Defined in this context, in order to become knowledge, information and data must be translated into frameworks, principles or general guidelines that allow people to take effective actions in the future. This is the challenge of knowledge management, because not all knowledge is created equal.

Knowledge comes in many forms. It can be broken down simply into two types. The first - explicit knowledge is that which is easily captured in writing: declarative knowledge, procedural knowledge, causal knowledge, and general knowledge. Properly documented explicit knowledge is easily transferred intact to others with minimal attenuation. This ability to easily document explicit knowledge lends itself to automation.

Data mining, mentioned before as a way to spot trends and patterns in data, is one technique used to discover knowledge. Used in this way, data mining becomes traditional data analysis methodology updated with the most advanced analysis techniques applied to discovering previously unknown patterns (Firestone, 1997). Yet these patterns by themselves cannot truly be called knowledge without first being interpreted and evaluated by users capable of placing them in context. Data mining is an important and useful tool in the creation of knowledge, but it will require significant advance in extant technology

before it can apply the experience, intuition, and judgment required to call it "Knowledge Mining" (Firestone, 1997).

The second category of knowledge: Tacit knowledge is even more difficult to capture than explicit. Tacit knowledge resides in people's heads in the form of instinct and values which, together, add up to experience - notoriously difficult to capture (Applehans, Globe, and Laugero, 1999). Tacit knowledge is highly personal and hard to formalize making it difficult to communicate or to share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge (Nonaka and Takuechi, 1995). Tacit knowledge is usually shared through highly interactive conversation, storytelling and shared experience, in contrast to explicit knowledge which is more precisely and formally articulated (Zack, 1999).

The value of tacit knowledge was illustrated in an interview Breen conducted with Gary Klein, a cognitive psychologist studying decision making by veteran firefighters and Air Force fighter pilots. During an interview with a fire chief, Klein found that the man had made a split second decision to pull his team out of a burning building, which collapsed seconds later, based on intuition and instinct (Breen, 2000). This intuition, supported by visual clues and patterns, allowed the fire chief to determine that this particular fire did not fit the model of normal fires he had seen over the course of 15 years, leading him to make the decision to evacuate. The fire chief was unable to explain why he had pulled the team out, other than to claim it was "ESP". This fits the research on tacit knowledge which shows it is extremely difficult to document and explain, even

for the experts. Knowledge may be inherently tacit or seem tacit because no one has yet been able to articulate it effectively (Zack, 1999). Tacit knowledge consists of schemata, mental models, beliefs, and perceptions so ingrained that users take them for granted. The cognitive dimension of this knowledge reflects their image of reality and vision of the future. Though they cannot be articulated easily, these models shape the way the world is perceived (Nonaka and Takeuchi, 1995). Unlike data and information, knowledge contains judgment. Not only can it judge new situations and information in light of what is already known, it judges and refines itself in response to new situations and information (Davenport & Prusak, 1998).

3. The Knowledge Management Life Cycle

Research has shown a cyclical life cycle exists in the knowledge management process (e.g., Nissen, Sengupta, and Kamel, 2000). Nissen, et al., examined several life cycle models proposed by various writers and developed the Amalgamated Model which incorporates the strong points of each, thereby creating a comprehensive look at the general knowledge management life cycle.

The Amalgamated model consists of six phases: create, organize, formalize, distribute, apply, and evolve (Nissen, Sengupta, and Kamel, 2000). The phases flow naturally, in order, eventually returning from evolve to create to begin the cycle again. Therefore, it is easier to visualize when presented as a circle, as shown in **Figure 2.1**. Nissen, et al., divide the activities into two classes representing "sharing" activities (Class I), and "non-sharing" activities (Class II).

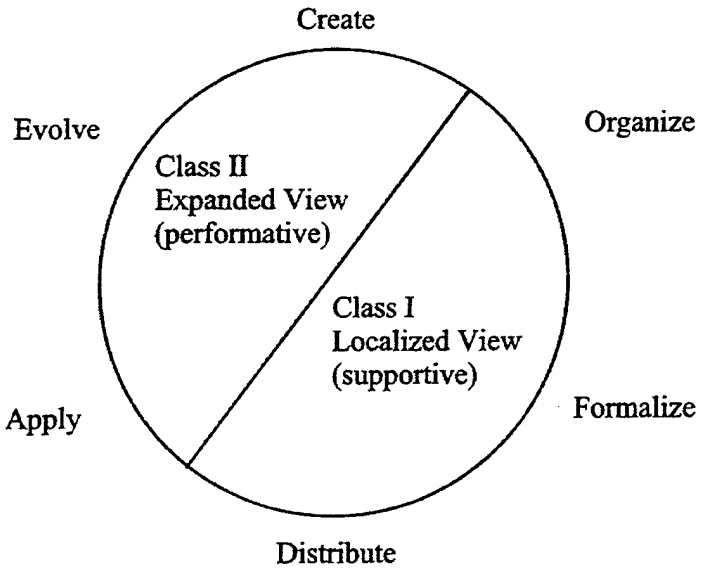

Figure 2.1 – Knowledge Management Life Cycle (From Nissen, Sengupta, & Kamel 2000)

The life cycle begins with the *Create* phase, which, at an organizational level, is the way, or process in which knowledge is created. Davenport and Prusak (1998) note that all healthy organizations generate and use knowledge, for without it an organization would be unable to organize itself, or respond to its environment. Organizational knowledge creation is the key to the distinctive ways that companies innovate. This helps bring about innovation continuously, incrementally, and spirally (Nonaka and Takeuchi, 1995). Organizations typically respond to information based on predefined rules, knowledge, experiences, and values. Knowledge creation involves discovery and the development of new knowledge. Many companies invest heavily in research and

development to gain a competitive advantage. Xerox is famous for its bench marking efforts in the 1980's used to regain a strategic advantage in the copier market (Jick, 1993). The recent emphasis on knowledge as a means of gaining advantage, has led organizations to continue seeking new and innovative ways to foster its creation.

The next phases: *organize* and *formalize*, are crucial to the success of the knowledge management process. Once the knowledge is created or discovered it must be documented or stored, and arranged logically to facilitate easy retrieval and use. Typically there are three types of knowledge repositories: (1) external knowledge (i.e., competitive intelligence); (2) structured internal knowledge, such as training manuals, reports, memos; and (3) informal internal knowledge like discussion databases, or lessons learned files (Davenport, De Long, and Beers, 1998). Leaders at HP created such a repository to assist their sales team, called: "Electronic Sales Partner" (ESP). ESP provided technical product information, sales presentations, sales and marketing tactics, customer account information, and anything else that might benefit field personnel. The managers added value to ESP through careful categorizations and pruning of information. HP managers called it the most successful implementation of software in 20 years (Davenport, et al., 1998). Success like this is possible only if the information and knowledge is well organized and its use is accepted as a preferred way of conducting business.

The organize phase can be difficult because extracting knowledge involves interpreting volumes of data and information to arrive at concepts and guidelines that can be documented, packaged, and delivered (Applehans, Globe, and Laugero, 1999).

Repositories, in order to further refine knowledge, should strive to record the rationale for actions or conclusions; circumstances and intentions surrounding the knowledge; and linkages between the various types of knowledge (Zack, 1999). Successful organization and formalization combined with thorough documentation will greatly enhance the future usability of the knowledge.

The *distribute* phase is the portion of the life cycle where the knowledge, which has been successfully created, organized, and formalized, is now communicated to those in need of it throughout the organization. There are many ways of sharing and transferring explicit knowledge: training manuals, online repositories, lectures/seminars, and memos, for example. Tacit knowledge, much harder to document, has traditionally been best transferred in a one-on-one format with the expert, or knowledge creator. This can take the form of: mentoring, apprenticeship, question and answer interviews, and sea stories, to cite a few examples. The most powerful learning, however, still comes from direct experience (Nonaka and Takeuchi, 1995). With the myriad of knowledge sources and channels available to potential users, it often becomes confusing trying to locate the best means of obtaining knowledge.

Many corporations are using knowledge librarians, or experts, to facilitate finding knowledge. They not only maintain the repositories, but also can link knowledge seekers with the appropriate knowledge resource (Marazzo and Connolly, 1999). Regardless of the person or technology used, an organization needs to assign responsibility for the seamless movement of knowledge from acquisition through use, as well as the interfaces

between these stages to ensure that knowledge repositories will be meaningfully created and effectively used (Zack, 1999).

Once the knowledge has been delivered to the end user, the life cycle enters the last two phases: *apply* and *evolve*. Organizations, in these phases, are achieving their goals for developing the knowledge management system – using knowledge to assist, improve, or speed up decision-making and possibly gain an advantage over competitors. Yet it still takes courage for managers to use someone else's ideas to achieve their goals. Creative people by their nature do not spend too much time on the ideas of other people. They want to make those ideas obsolete with new discoveries of their own (Saaty, 1994). Therefore it is imperative for the organization to foster a culture, which embraces the sharing of knowledge and its reuse so that they can maximize the rewards of its application.

As other individuals and teams begin to use knowledge from the repositories, they will undoubtedly find new applications for it, or make improvements based on their own experiences and the contexts in which they are applying the knowledge. This continued evolution of knowledge is important to capture, broaden, and improve the usefulness of the knowledge base. The essence of innovation is to re-create the world according to a particular idea or vision. Creating new knowledge means to re-create the company and its employees in an ongoing cycle of self-renewal (Nonaka and Takeuchi, 1995). The successful capture of this evolved knowledge is essential to completing the cycle and becomes the first part of a new cycle.

4. Capturing Knowledge

The capture of knowledge spans the *create* and *organize* phases of the knowledge management life cycle. The goal of capturing knowledge, often referred to as codification, is to put organizational knowledge into a form that makes it accessible to those who need it. It literally turns knowledge into a code to make it as organized, explicit, portable, and easy to understand as possible (Davenport and Prusak, 1998). There are several steps organizations need to follow in order to foster a knowledge creating environment: (1) Establish a culture of sharing; (2) Open communications; and (3) Develop a system for effectively capturing the knowledge generated.

a. The Knowledge Creating Culture

Organizations, to effectively create, share, and leverage knowledge, must foster a climate and reward system that values and encourages cooperation, trust, learning and innovation. They must provide incentives for engaging in knowledge-based roles, activities, and processes (Zack, 1999). Without this culture of trust and cooperation, any technology application will fail – or as Marazzo and Connolly (1999) put it: "No technology has yet been invented to convince unwilling managers to share information or even to use it." When an organization fails to create a climate friendly to knowledge sharing it will begin to show signs of being sick, or lacking creativity.

Sick cultures are characterized by resistance to change, inadequate communications, lack of candor, resentment of criticism, and a completely task-orientated predilection (Serpa, 1994). There is also a reluctance to allow criticism from within as well as without. Criticism of existing practices and the suggestion of new concepts and

principles are perceived as threatening and destructive. Such cultures may lack pride in performance, discipline, and delegation of authority. Individuals will not feel free to contribute to the creation of knowledge, or its refinement. Any knowledge projects will wither on the vine. A hyper competitive environment is about as far away from the ideal that an organization can go in a knowledge-creating context. It can lead individual members to act in an untrustworthy fashion, avoid helping out, engage in gaming, unduly criticize new and potentially valuable ideas, and refuse to offer their valuable feedback during the learning process (Von Krogh, Ichijo, and Nonaka, 2000). People in sick organizations fear layoffs, or being fired for making a mistake, and will be reluctant to share any information about mistakes or failures even though this knowledge may be valuable to the company and could prevent others from making the same errors (Davenport, De Long, and Beers, 1998) Knowledge management projects within the right culture can flourish and provide the sought after benefits.

Those organizations that are most successful at knowledge management tend to employ people with a positive orientation to knowledge. Their employees are bright, intellectually curious, willing and free to explore, and executives encourage their knowledge creation and use (Davenport, De Long, and Beers, 1998). Here, people are not afraid to share knowledge, nor are they fearful of mistakes. The organization has encouraged knowledge sharing by rewarding contributions, either through recognition, promotion, monetary bonus, or with its evaluation criteria. These groups often have managers that realize the most accurate definition of problems can occur at the lower

levels of the hierarchy. Often the solutions can be conceived on the front lines earlier than at higher levels. Therefore to avoid solving the wrong problem, or ignoring the people actually experiencing the problem first-hand, managers should encourage open communications, candid dialogue, and problem solving among employees to deal with these critical, rapidly evolving situations (Serpa, 1994). No one department or group of experts has the exclusive responsibility for creating new knowledge. Front-line employees, middle managers, and senior managers all play a part. The creation of new knowledge is the product of a dynamic interaction among them (Nonaka and Takeuchi, 1995).

Managers can purge the process of distrust and fear by breaking down personal and organizational barriers. This will allow effective conversations and higher creativity, which in turn stimulates the sharing of tacit knowledge, concept creation, and justification, all of which facilitates the flow of knowledge (Von Krogh, et al., 2000). Once leaders have identified the culture of their organizations, they can more astutely implement knowledge projects that mirror their organizational values, and give those projects a better climate in which to succeed. One of the results of establishing a culture of sharing and cooperation within organizations is that it will open up communications and promote conversations, which are the seedbed for knowledge creation.

b. Knowledge Creating Communications

While there are many methods for generating and sharing knowledge, one of the most effective is conversation. Whether the conversations take place around the

fabled water cooler, in seminars, in one-on-one interviews, or in on-line chat rooms, knowledge that has not yet been codified is transferred to potential users and new ideas are born (Hansen, Nohria, and Tierney, 1999).

> Good conversations are the cradle of social knowledge in any organization. Through extended discussions, which can encompass personal flights of fancy as well as careful expositions of ideas, individual knowledge is turned into themes available for others. Each participant can explore new ideas and reflect on other people's viewpoints. And the mutual exchange of ideas, viewpoints, and beliefs that conversations entail allows for the first and most essential step of knowledge creation: sharing tacit knowledge within a micro community. (Von Krogh, Ichijo, and Nonaka, 2000)

This concept of Micro-communities, as used by Von Krogh, et al., appears in many of the readings under various titles: Knowledge Forums (Zack, 1999); Communities of Practice (Nissen, Kamel, and Sengupta, 2000); and the Knowledge Marketplace (Davenport and Prusak, 1998). Regardless of the name, the concepts are similar. Micro-communities are characterized by face-to-face, or virtual interactions, and where members gradually get to know more about each other's personalities, fields of interest, possible agendas, and the corresponding forms of behavior that may or may not seem acceptable to the rest of the group (Von Krogh, et al., 2000). The format of these communities tends be extremely interactive and complex, often spanning the entire tacit/explicit knowledge processing cycle (Zack, 1999). A healthy exchange of ideas and knowledge via micro-communities, or one-on-one groups, enables employees at all levels to gain a greater sense of satisfaction knowing that their ideas matter. They also will better understand what is happening throughout the organization (Davenport and Prusak,

1998). These communities can take shape in a variety of formats and ways; however, the dominant forms are face-to-face (physical), and online (virtual) communities. Each has its advantages, and each face the same issues of trust and identity, clarity of purpose, and boundaries (Mieszkowski, 2000).

The greatest advantage of meeting face-to-face is the ease of communication, and the personal nature of the meetings. When sharing knowledge both the "buyer" and "seller" need to evaluate each other's trustworthiness and repute (Davenport & Prusak, 1998). This is easier to do in person, or by building networks of knowledge shared by word of mouth. Knowledge sellers want to be known as reputable experts in their field, and may expect some type of reciprocity for their efforts, either in the form of future help, acknowledgement for their expertise, or simply being appreciated. The buyer wants to know that he is getting the best advice from a trustworthy source (Davenport & Prusak, 1998). Personal meetings provide an easier method to share the knowledge as well as building trust.

When people meet face-to-face, they can decide whether the knowledge sharing will take one of many formats. They may establish a mentoring relationship, where the knowledge is passed along from master to apprentice over the course of time. It could take the form of people meeting over drinks at a local club sharing stories of work, not only passing along organizational knowledge, but bonding as well (Von Krogh, Ichijo, and Nonaka, 2000). Another form of personal sharing is the consultant, hired to fix a problem within the company, who arrives and shares his expertise for a brief period of

time (Hansen, Nohria, and Tierney, 1999). Regardless of the form of personal contact, the biggest obstacle with informal personal meetings and conversations is capturing this knowledge and successfully documenting it (Davenport & Prusak, 1998). Another disadvantage is the lack of breadth of knowledge available in a local office, or arm of an organization compared to what is available within the entire organization. There is a need to combine experiences across communities, to broaden the scope of experience, and involve as many experts as possible (Zack, 1999).

Online micro-communities, on the other hand, have the advantage of spanning large geographic areas and time. It also becomes easier to capture the topics and answers in databases for quick recall at later times. While virtual communities are great at overcoming some of the obstacles faced by traditional face-to-face communities, they are not without their own barriers. Online you are presented with the problem of establishing a persistent identity for the people involved in knowledge sharing. Other users still need to know a seller's background in the subject matter, what type of experience they have, how long they have been consulting, how accurate has their advice been in the past, and other pieces of information to help them decide how reliable the seller's advice is (Mieszkowski, 2000). Davenport and Prusak (1998) note that "one of the drawbacks to electronic knowledge markets is the variable quality and lack of personal contact, which tends to reduce trust and commitment, and is likely to mean a devaluing of on-line knowledge, which will probably be ignored or treated with suspicion unless it has been evaluated and edited by a respected on-line broker." Regardless of which venue an

organization chooses, it needs to be aware of and develop a plan for coping with the obstacles it will encounter.

c. Codifying Captured Knowledge

Once the organization has developed an appropriate culture for knowledge creation and capture, the next challenge is finding a way to codify the new knowledge. Codifying knowledge provides several benefits to the organization. First, it gives a way to capture and transfer useful knowledge resident within the organization. Second, it establishes uniform procedures and practices, and helps define quality standards (Nissen, Kamel, and Sengupta, 2000). Codification also allows companies to benefit from its reuse; true especially with highly explicit knowledge where codification takes the form of training manuals, books, software, or another highly distributable and widely used form (Hansen, Nohria, and Tierney, 1999).

Knowledge managers, to make codification work, must have an excellent understanding of the business goals of the organization prior to creating the knowledge requirements (Applehans, Globe, and Laugero, 1999). The managers need to identify what the organization knows, and in what form that knowledge exists (Von Krogh, Ichijo, and Nonaka, 2000). They must also determine usefulness, which is a judgment made about knowledge from a particular vantage, from the perspective of some user or set of users, or historical perspective (Louis, 1994). Once an organization has determined the value of its knowledge it's faced with the task of deciding how best to document, or codify it so as not to reduce it to the level of information.

The easiest knowledge to codify is explicit knowledge. Explicit knowledge can be described in writing, and shared via memos, manuals, CD-ROMs, corporate intranets and web sites, or via any number of methods. Tacit knowledge is much more difficult to capture. Sharing tacit knowledge between individuals through communication is an analog process that requires a kind of 'simultaneous processing' of the complexities of issues shared by the individuals. Explicit knowledge, on the other hand, is about past events or objects and is oriented toward a context-free theory (Nonaka and Takeuchi, 1995).

Some organizations, such as the military and business schools, are strong advocates of using case studies and lessons learned files to document historical scenarios to help others gain tacit knowledge by giving them an historical context for past events, to facilitate understanding why the people involved made the decisions they did. This context, however, can be a drawback unless there is extensive documentation, or first hand sources available. Without these resources the readers may be unable to understand motivations, or reasoning behind the decisions illustrated. Other knowledge engineers are going beyond written analysis to study cases and decisions by using technology, such as expert systems to codify the knowledge of experts.

Knowledge engineers, designing expert systems, must take acquired knowledge and attempt to build a knowledge base. This is typically done by interpreting and integrating human answers to questions, drawing analogies, posing counterexamples, and bringing to light conceptual difficulties (Turban and Aronson, 1998). Once captured,

the knowledge base combined with heuristics can be used by a computer or inference engine to solve specific problems. This is a very expensive and time-consuming method to capturing knowledge. Expert systems have a variety of applications, and are particularly useful when used as: interpretation systems, prediction systems, diagnostic systems and design systems (Turban and Aronson, 1998).

Aside from expert systems, and other highly technical approaches (e.g.: neural networks) there are means to codification of tacit knowledge which may include: taped interviews, extensive question and answer exchanges – either oral or written, and knowledge maps to help seekers locate organizational experts. The objective of mapping knowledge is to visualize the organization's knowledge and those responsible for maintaining, or documenting different kinds of content, and to make it easy for users to locate that content (Applehans, Globe, and Laugero, 1999). Maps can facilitate connecting people to the company experts in the area of knowledge they are working. However, to be truly useful the maps must be updated frequently, and easily distributable or accessible. This almost necessitates delivery via intranets or extranets with content available via browsers in multiple locations (Applehans, et al., 1999). This also means the organization must place a capable, networked device on every desk or in every briefcase, with standardized personal productivity tools, so that people can exchange documents easily (Davenport, De Long, and Beers, 1998).

There are numerous companies offering "knowledge management" tools for corporate networks today, but before opting for a particular solution, organizations

must first identify their needs, the type of knowledge being captured, and how it's to be distributed.

B. CHANGE MANAGEMENT

1. Rationale for Change Management

Change management is a popular topic in the business press because organizations face numerous changes and their associated challenges on a daily basis. Due to increasing sophistication and complexity in today's business environment, the need for innovations in the use of advanced information systems, organizational structures, and improved production methods and machinery becomes evident (Conner, 1992). Implementing these numerous changes can, however, result in mass confusion on the part of the people actually affected by the change. Organizations, like individuals, can only absorb so many changes at one time. Therefore, it is necessary to examine how changes can be introduced without totally disrupting the organization.

2. Types of Change

Change is not new to business or the world in general. As time goes by there are a countless number of changes taking place around every organization, and in every environment, many of which are too small to notice. These changes can be classified in two ways: (1) Incremental or Continuous Change, and (2) Radical or Discontinuous Change (Nadler & Nadler, 1998).

Incremental or continuous change can be further described as being either *developmental*, or *transitional*. Developmental change occurs when a skill, method or

condition that is somehow deficient, or not meeting expectations, is improved over the course of time. It is the improvement of "what is" (Jick, 1993).

Transitional change on the other hand is the slow evolution of ways of doing things. The old is replaced with the new through a series of transitional changes to systems, processes, technologies, and the like (Jick, 1993). This is not a radical process requiring buy in from every employee prior to implementation, but a slow deliberate change. This type of change is happening all the time throughout the world.

Radical or discontinuous change on the other hand is transformational – it requires a leap of faith for the organization, and often is instigated when there are no alternatives left (Jick, 1993). Typically, discontinuous changes require a dramatic change in strategy and abrupt departures from traditional work, structures, job requirements, and cultures, which in turn necessitate a complete overhaul of the organization (Nadler & Nadler, 1998). The end of the Cold War and the bipolar way of viewing world power is a recent example of discontinuous change. Seemingly overnight, the old USSR ceased to exist and left the rest of the world scrambling to figure out how to manage political power in the post-Cold War era.

3. When is Change Necessary

Change for an organization can occur at any time - when things are going well, or when going poorly, and sometimes it's done simply to invigorate a situation that, while not failing, is still not going along as well as expected (Jick, 1993). Most organizations either anticipate the change coming and take steps to plan for it, (typically the case with

incremental and deliberate changes.), or, in the case of discontinuous change, organizations are reacting to a rapidly changing environment (Nadler & Nadler, 1998).

Identification of the need to change can be extremely challenging. Andy Grove, CEO of Intel, stated, "Nobody will ring a bell to call your attention to the fact that you are entering into [a] transition. It's a gradual process; the forces start to grow and as they do, the characteristics of the business begin to change." (Grove, 1996) Change is an opportunity for many people to improve the way business is being conducted, and managers are expected to stay in touch with all aspects of the business to keep an eye out for areas needing change, or being changed (Grove 1996).

Even when an organization can anticipate a coming change, it is still not always easy to make the change. Many may not see the need, and require a higher standard of proof from those that do. Yet, it's not healthy for an organization to continually wait for a crisis to arise prior to implementing change. Before change can take place managers must be dissatisfied with the status quo enough to generate the enormous amount of energy to change (Beer, 1988). Or, as Connor (1992) states, "Keeping major change alive is only possible when the pain of the present state exceeds the cost of the transition state." When to change, thus, requires an exquisite sense of timing and energy. The challenge is to choose the time when the organization should make changes and can do so (Jick, 1993).

4. Barriers to Change

When the time is ripe to implement change within an organization, and management is sold on the need to do so, what else could stand in the way of success?

There are a surprising number of barriers, any one of which can trip up a change program. It's easy enough to roll out a new technology solution by changing hardware, and installing new systems, yet it's not always so easy to convince the people they actually need to use the new system. Without the support of staff, the technology is worthless. Therefore it's necessary to address the concerns of the employees.

Fear of various losses is the primary motivation to resist change on behalf of those affected (Beer, 1988). Literature (e.g.: Beer, 1988; and Nadler & Nadler, 1998) has identified typical losses which employees fear: *Power* – either individually or as a group, loss of power has implications for influence, careers and status; *Competence* – anxiety over having to learn new skills and the realization that old expertise is obsolete; *Relationships* – changes in the established order may require new networks; *Rewards* – loss of tangible or intangible benefits such as pay, office size, or title; and *Identity* – a change in the role of individuals combined with other losses. These fears, while enough to derail a change project on their own, can be further exacerbated by a lack of understanding and trust.

Employees who are not part of the decision to change, who are not allowed to discuss the change or their feelings toward it, and who are cut off from the decision making process, are likely to feel disenfranchisement from the overall effort (Connor, 1992). Managers must take whatever steps are necessary to regain trust, and to get the employees involved in the change process from the beginning. They must take the time to put employees in touch with the same data that led to their dissatisfaction with the status

quo (Beer, 1988). Middle management has a strong role to play here. They are in the best position to project the need for change throughout the organization and enlist support, ideas, and feedback from front line employees (Grove, 1996). Management must take the steps necessary to overcome the impression that this is just another "program-of-the-quarter" idea dreamed up by management to solve imagined or insignificant problems.

5. Overcoming Obstacles to Change

Implementers of organizational change face a daunting task. They face a large number of obstacles and a myriad of personal relationships to manage in overcoming resistance to change. Beer, Eisenstat, and Spector (1990) offer a six step program that encompasses much of the thought on how companies can avoid the pitfalls associated with change programs. These steps include: mobilizing commitment; developing a shared vision; building consensus; spreading revitalization; institutionalizing revitalization; and monitoring and adjusting strategies in response to problems.

The first step *Mobilize Commitment* is the way to assure support for the change effort among key power groups beginning well before the change is announced (Nadler and Nadler, 1998). Getting top management and key stakeholders to see the need for the change is critical. Change leaders must build up desire to see the status quo altered, and generate the energy required to get the change project off the ground. Doing this successfully will often prompt ad hoc groups to form on the periphery of the organization to discuss how to implement changes (Beer, et al., 1990). Groups on the periphery can

often build the local successes and momentum needed to spread the change to the rest of the organization.

Develop a Shared Vision of how to get organized and accomplish the goals for the change is the second step in the change process. The shared vision is a more detailed, task aligned view of the problem (Beer, et al., 1990). It becomes a means to document the way things should be in the future, and provides a pattern to follow to achieve the goal. It is necessary to create a consensus around this vision, and to refine it as needed to gain everyone's commitment. This way employees will judge it more acceptable than statements issued from the top management tier (Beer, et al., 1990). People are more likely to support and take responsibility for projects they help create. This approach will help produce the commitment necessary for successful change (Conner, 1992). Few activities boost understanding more than working on a vision statement that will be used to explain the change to others (Nadler and Nadler, 1998).

Even though employees may have helped write the vision statement, or made contributions to it, it is still important to *Foster Consensus* for the new vision. Consensus building is not the same as consensus management. Inviting employee participation does not mean that management has relinquished its responsibility for final decisions. Management is instead exercising its responsibility by choosing to involve employees in reaching these decisions (Conner, 1992). Not every employee will participate in the drafting of the vision, nor will all agree with it. It is important therefore to actively promote the vision at all levels of the organization to achieve acceptance. Since the

changes being envisioned will have grown out of employee input and experiences, this should not be as difficult to achieve, as would be the case had they not been consulted. This is also an important point at which to identify those who cannot accept the vision or function in the new organization, and have them replaced (Beer, et al., 1990).

Once the vision has been accepted, and change has begun, it is time to *Spread Revitalization* to other areas of the organization. This spread should be more like a contagious virus spreading through the organization, than a force fed change from the top. Top management should look for early success stories, big or small, and share those with other groups in the organization. They should let each group find its own way to implement the changes in accordance with their situation (Beer, et al., 1990). This will allow each section the opportunity to take ownership for the change, and tailor it to fit their organization, rather than completely destroying their group to implement the corporate program. Innovative units need support and resources to encourage duplication. Top management can speed up adoption by publicly and loudly praising and rewarding successful adaptations of the new program (Nadler and Nadler, 1998). This will help leaders to develop an environment in which people are passionately dedicated to winning, and not too afraid to try early adoption, or to risk failure, to achieve the corporate vision (Grove, 1996).

The fifth step, *Institutionalize Revitalization* through formal policies, systems and structures, should follow on the heels of the initial successes. Once the changes have progressed past the early stages of resistance and gained acceptance throughout the

organization, it will become necessary to begin formalizing the system (Beer, et al. 1990). It is better to allow the change to mature and to learn the critical interdependencies amongst the various groups prior to formalization, to allow time for adjustments and kinks to be worked out of the system (Beer, et al., 1990).

The final and ongoing step is to *Monitor and Adjust* strategies in response to problems. This final step helps assure the organization that, either the change accomplished what it needed, or that it needs to continue to be modified and fine-tuned. Just as every organization is different, each change process is unique.

One constant in the change process is the requirement for strong leadership. Most successful changes were the result of strong leaders with a passion, a vision, and courage for making the changes, people such as: Lee Iacoca at Chrysler, or Jack Welch at GE. Leaders may be individuals, teams, or "empowered" workers implementing their own plans for change, or those of the company.

C. THE DEEPWATER CUTTER COMMUNITY

1. Description of the HEC/MEC Community

The Coast Guard classifies any ship 65 feet long, or greater as a "cutter". Cutters 65 feet or greater, that routinely patrol beyond 50 miles from shore for extended periods of time are considered "deepwater cutters". This community in particular contains High Endurance Cutters (HEC) and Medium Endurance Cutters (MEC). The Coast Guard operates other more specialized cutters greater than 65 feet such as buoy tenders, ice breakers, and the barque Eagle; however, it is the HEC/MEC cutters that will be described.

These cutters range in length from 210 feet through 378 feet, and traditionally operate away from homeport for several months at a time, averaging 180 days at sea each year. The size of crews varies with the size of the cutter, but is typically between 90 – 150 people. A cutter's crew consists of approximately ten to fifteen officers, six to ten Chief Petty Officers, and 60-80 enlisted. Most crews are made up of men and women, ranging in age from 18 – 50, coming from a wide variety of educational backgrounds.

The HEC/MEC platforms are considered multipurpose cutters. They are equipped to operate independently, as part of a naval task force, or with foreign allies. Most are lightly armed, able to exercise self-defense against other naval vessels and aircraft, and capable of enforcing U.S. laws and treaties. All are able to support an embarked helicopter.

The Coast Guard's chain of command for deepwater cutters places them under the command of Area Commanders (Atlantic/Pacific). (See Figure 2.) HEC/MECs remain under their respective Area Commander's operational control until assigned to another command for a specific patrol. District Commanders typically submit a request for the number of HEC/MEC patrol hours needed to cover operational needs. Cutters are then assigned to support the Districts.

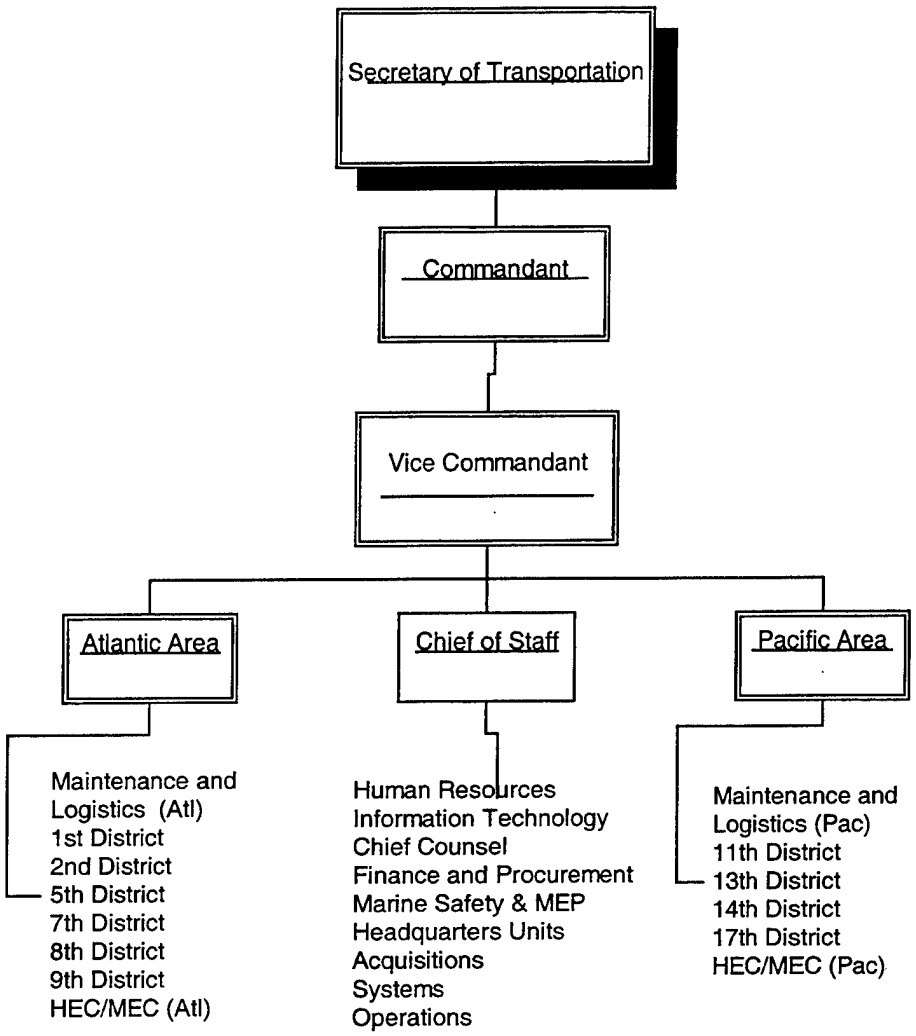

Figure 2.2 - Organization of the U.S. Coast Guard, 2001. (From USCG, 2001)

2. Missions / Patrols

The Coast Guard operates in all of our nation's maritime regions - inland, coastal, and deepwater: deepwater missions include operations 50 miles or more out to sea. Unlike operations in coastal and inland waterways, deepwater missions typically require a long-term, continuous, on-scene presence, often with deployments away from home stations for several months on end. Deepwater missions also demand the ability to operate

in severe environments - from Arctic to tropical and equatorial climates - 24 hours a day, every day, wherever the demands of national security require the Coast Guard's humanitarian, law enforcement, or military presence. Overall, the Coast Guard performs fourteen statutorily mandated missions in the deepwater regions around the globe, which fall into four main categories: Maritime Law Enforcement, Maritime Safety, National Defense, and Marine Environmental Protection (USCG, 2001).

Ever since 1790, when the Revenue Cutter Service was formed, *law enforcement* has been a primary responsibility of the Coast Guard. 14 UCS 89 (a) specifically gives Coast Guard officers and petty officers the unique authority to make inspections, searches, seizures, and arrests for the prevention of violations of laws of the United States. Today this mission has become multifaceted as Coastguardsmen are called upon to halt the influx of illegal drugs; interdict the flow of illegal maritime immigration; and to preserve the nation's fisheries through enforcement of U.S. fisheries laws (USCG, 2001).

The Coast Guard's role as America's Lifesavers, and its *maritime safety* mission, extends back to its existence as the Revenue Cutter and Life-Saving Services. Starting in 1832, cutters were directed to render assistance to vessels in distress as a specific duty. The connection between the cutters offshore and the Life-Saving Service became strong, a bond made complete with the advent of the Coast Guard in 1915. The Coast Guard still relies on the personal courage, dedication, and unique skills of its personnel to protect lives and property at the mercy of angry seas (USCG, 2001).

Coast Guard *National Defense* Operations are conducted in support of Navy Aircraft Carrier Battle Groups and Marine Corps Amphibious Ready Groups. Within these groups, Coast Guard cutters conduct a wide range of missions and tasks that contribute to the common defense and overall effectiveness of the fleet. In addition to the Maritime Defense Zone responsibility for protecting domestic ports and harbors, General Defense Operations include force protection, search and rescue, surface warfare, and under-sea warfare missions. The Departments of Defense and Transportation signed a Memorandum of Agreement, in October 1995, formalizing the use of Coast Guard capabilities during defense operations and outlining four additional responsibilities: Maritime Interception Operations; Environmental Defense Operations; Deployed Port Operations, Security, and Defense; and Peacetime Military Engagement (USCG, 2001).

The Coast Guard's role in *marine environmental protection* dates back to the 1822 Timber Act, which tasked the Revenue Cutter Service with protecting government timber from poachers. The Oil Pollution Act of 1924, which forbade the discharge of oil into American coastal waters, was the first case of the Service being tasked to monitor a single environmental issue (which protected the environment as a whole) instead of a specific resource. Today the Coast Guard protects the critical natural resources located in the United States' 2.25 million square mile Exclusive Economic Zone (EEZ), including a wide range of prevention, protection, containment, and recovery activities (USCG, 2001).

A HEC/MEC patrol can encompass aspects of all four mission areas. It would not be unusual for a cutter to depart on a maritime law enforcement patrol, take a week out of

the schedule to conduct joint military operations with USN ships, respond to a search and rescue case, and take action against a vessel illegally discharging oil, or some other pollutant into the sea. Some deployments are primarily focused on National Defense, such as HEC/MEC deployments with a naval battle group to the Persian Gulf, or in support of training exercises in South America and Europe. However, Coast Guard cutters, in keeping with their motto, Semper Paratus (Always Ready), must be prepared to conduct any mission at any time.

3. The Command Culture

Since people first started going to sea there has been one indisputable rule of shipboard life: the captain is the supreme authority on board. For commissioned cutters, authority and responsibility is invested in the captain of the cutter, and the unequivocal requirement is made for obedience to his command. Admiral Long, USN, summed up command responsibility:

> Command involves responsibility, and responsibility is something that an individual either has or does not have. People who are in the chain of command must clearly recognize that they can delegate most or all of their authority, but they can never divest themselves of their responsibility. The commanding officer is 100 percent responsible for what goes on in a missile division; clearly the gunnery or weapons officer is 100 percent responsible; and the division officer is also 100 percent responsible. An understanding and appreciation that responsibility is absolute is critical to an officer doing his job. (Monter, et al., 1987)

Not only does command entail full responsibility for the vessel, the crew, and their actions, but it, of necessity, gives the commanding officer full authority over the cutter and crew. It has long been recognized that officer and enlisted must always fully

comply with the decisions, orders, and directives of their seniors. However, these orders and directives must be within the authority of the seniors, and must be legally and morally appropriate, and must not exceed the capability of the recipient (Monter, et al., 1987). Service members receiving orders must bear in mind that their seniors have one more level of responsibility and have greater information. Doubt about the orders or directives can be handled through appeal to higher authority. But, they must always be prepared to accept responsibility for the disruption this may cause. Coastguardsmen are all voluntary participants in this autocratic system, and all took oaths swearing to obey the orders of those appointed over them (Monter, et al., 1987). Therefore, lawful orders, no matter how trivial, should be promptly obeyed.

Given the nature of this autocratic system, it would be easy to abuse it by being overly directive. Yet the goal of command is to train subordinates to function independently, and to do so the command must provide the crew with a rich variety of experience and tasks. It is important, in this regard, to the development of good leadership to allow the future leader to carry out his task free of intimidation and interference. Seniors up the chain of command cannot have knowledge of all the small details of daily work. Interference would dampen the joy to serve and diminish the subordinate's accomplishments (Monter, et al., 1987). For this system to work, the senior and subordinate must develop a sense of complete trust – trust that the orders given will be appropriate; and trust that once given, the orders will be executed appropriately to the best of the subordinate's ability.

Great commanding officers are not born, or even produced in military academies; they are developed throughout their careers by learning and years of experience. General W. H. Rice, USMC, stated leaders must "Know yourself, know your troops, and know your job!" (Monter, et al., 1987) Only by seeking demanding jobs and observing fellow leaders, both good and bad, can leaders expand their abilities and knowledge. They must learn from their subordinates as well as their seniors and peers, and continually expand their level of knowledge. James Webb, when Assistant Secretary for Defense felt that:

> Whether he is a squad leader or the nation's president, a leader must always follow certain principles. One of them is knowledge – knowledge of the subject matter of his leadership, knowledge of the individuals he is serving and the individuals who are serving him, knowledge of human motivation (Monter, et al., 1987).

While knowledge is a key element of leadership, so is the ability to use it properly. It is good for leaders to know what they are doing, but they must convey that to subordinates in a way that tells subordinates that they are seen as part of a team, and not as slaves who must carry out the will of the most senior individual (Monter, et al., 1987). Being part of a team means also that the leader must be eager to receive feedback from the team, and be open to advice. A leader who routinely ignores advice, or disparages those who offer opinions, will soon stop receiving that feedback, and may begin to miss many opportunities to succeed.

When planning a mission or task, a leader has the option of completing the plan on his own, or seeking advice from experts, either junior or senior to him in the command. His crew will need to be well informed about what they are expected to do,

and when appropriate, should be allowed to contribute to the planning process. By communicating command goals and mission objectives he will create a common vision and expectations. This will allow his shipmates to feel a sense of trust and be able to avoid or resolve conflicts quicker than if they perceived all decisions as edicts from an unyielding boss (Monter, et al., 1987). This also gives the advisors a vested interest in the leader's success, because they participated in making the plan.

The nature of the job on board Coast Guard cutters necessitates the autocratic command structure of a military vessel. When operating properly, this culture allows for the smooth execution of orders in critical situations, that would otherwise be impossible under more flattened hierarchies. Rapid obedience to orders is essential to the well being of the crew and cutter. This, however, does not mean the cutter is run as a dictatorship. This system has served well for the past 211 years, and is well entrenched, in one form or another, on board every cutter in the fleet.

4. Barriers to Change

Implementing changes on board cutters in the HEC/MEC community is no different in most respects than implementing change in any large organization. Agents of change must overcome the same hurdles and human fears that their corporate counterparts face. There is one particular obstacle that is more magnified in the military culture than in most corporate settings, however – tradition. Military tradition goes back hundreds, and sometimes thousands of years. Officers and enlisted are trained and taught their services' traditions from the time they arrive in boot camp or leadership schools, to

the time they retire. Proffering changes to these traditions not only evokes normal fears, but raises emotional and passionate debate as well.

Onboard military vessels, since the age of sail, sailors have been called to chow lines by the boatswain's mate's pipe. This long shrill chow pipe with it's distinctive tones and trills was essential for communication on sailing vessels where this, and shouting, were the routine means of communication. Modern ships use the 1MC, an amplified speaker system installed throughout the ship to notify all hands of important events, including meals. Yet on many ships, chow pipes are still used. Why? Tradition. There is no practical need for the pipes, they require training to be sounded properly, and it requires a skilled person at the proper station to sound them. The amplified speakers magnify the already loud sounds and sailors often reach to turn down the volume of these speakers during the pipe – which if not readjusted, can result in important messages being lost later. Yet there are few captains on deepwater cutters who wish to do away with one of the long-standing nautical traditions that form the fabric of the service and its culture.

Tradition remains an important consideration when contemplating change on board any Coast Guard cutter, and should never be dismissed or taken lightly. The service depends on these traditions to bond its members, past and present, and to form the camaraderie necessary to demand the sacrifices so often required in the service of the country. Any change in these realms must be approached with caution and reasoned discrimination.

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III. CURRENT KNOWLEDGE MANAGEMENT PRACTICES

The High Endurance Cutter and Medium Endurance Cutter community has developed many practices for sharing knowledge among cutters, and with shore units. The practices have developed around the primary means of communication in use by the fleet, personal meetings and written communications. Within these categories the most frequently used methods for sharing knowledge are explored through the sections below. Although the list is not comprehensive, the methods selected are illustrative of current practices, as discussed in interviews with officers having extensive experience within this community.

A. PERSONAL MEETINGS

The oldest method for sharing knowledge amongst service members is the personal conversation, or meeting. These personal exchanges can take many forms, however some of the more structured ways used within the HEC/MEC community include: the assignment process (e.g., formal schools, turnover procedures), homeporting, CO's conferences, refresher training, and mentoring. Each of these is discussed in turn.

1. Assignment Process

The assignment process begins when assignment officers start looking for service members suitable to fill shipboard billets. One criterion, particularly for more senior enlisted and officer positions, is experience and knowledge. Reviews of previous

assignments, personal evaluations, reputation, and personal desires also factor into deciding whether a member is selected for assignment to a billet.

Each billet requires specific skills and, in many cases, formal training. If a member assigned to the billet does not possess the requisite training, he or she is sent to a training command to attend school. The formal schools use instructors, who have proven themselves experts in their fields, to teach the members the skills required for their jobs. In addition to personal interaction with the instructors, students have an opportunity to gain knowledge from their classmates as they share experiences and knowledge during the course of the training. This one-on-one experience, combined with other school materials (e.g., texts, doctrine, audio/visual aids) is a critical step in preparing the service member for their new billet.

A second process, equally critical for personnel assigned to replace senior personnel (e.g., CO, XO, Department Heads, Command Enlisted Advisor) on the cutter, is the turnover procedures. One of the greatest challenges for any cutter in the HEC/MEC community is managing personnel turnover. Officers are ideally assigned to a cutter for a two-year tour of duty and enlisted personnel for three. Enlisted tours can vary significantly depending on advancement and retention rates, while officers, with few exceptions, serve two years before rotation. The more senior personnel are, the more critical it is to have stability for their assignment. Junior personnel, especially the non-rates (E1-E3), tend to be the most volatile due to assignment to schools, or advancement and reassignment.

The most critical positions are the Commanding Officer (CO), Executive Officer (XO), Department head billets, and senior enlisted billets. This is due to the experience and training required by personnel filling these jobs. The loss of any one of these personnel means the departure of a significant amount of operational and organizational knowledge. Rotations are staggered as much as possible to avoid a complete vacuum of knowledge from the sudden departure of this command cadre. A relief process with the incoming replacement usually accompanies the departure of senior personnel.

The relief procedures ideally include a brief period of overlap of incoming and outgoing personnel. The incumbent uses this time to review cutter procedures and policies, status of material and funds, status of personnel and training, and any insights and knowledge gained in the course of her tour that may be helpful to the new officer. The time allotted for this process is usually a week, possibly longer for the CO or XO, but often times shorter.

The relief process usually leaves the incoming person with enough information to get started and to know the basic strengths and weaknesses of their division, department, or ship. However, it takes several weeks, or months, for the people to fully bring themselves up to the level of knowledge to be considered proficient. This period varies greatly with the person's level of experience and position. Cutters will often send "Welcome Aboard" packages out as soon as the new person has orders to help ease the transition to the new environment.

Welcome Aboard packages and sponsors try to provide incoming personnel with resources to contact so they can learn as much as possible about their new job prior to arrival. The package contains basic ship's instructions and expectations. Sponsors will typically brief the incoming person on their job, and what will be expected upon arrival. This will vary with cutters and sponsors. Communications at this stage of the turnover process are via e-mail, phone calls, written correspondence, and, when practicable, with personal visits.

The goal of the assignment process is to minimize the loss of knowledge and corporate experience from the cutter's crew. This is done through formal training, staggering rotation dates, assigning good sponsors, and maximizing relief time. Despite these efforts, it is nearly impossible for anyone, no matter their level of knowledge or intelligence, to be expected to complete the process and have the same level of job proficiency or knowledge as the incumbent.

2. Homeporting

The logistics involved with supporting a military vessel pier side have often driven the Navy and Coast Guard to achieve economies of scale by locating numerous vessels together in common homeports. Aside from logistical and financial issues there are excellent reasons to do so from a knowledge management perspective.

The Coast Guard has found that maintaining the increasingly sophisticated systems on its cutters requires a vast amount of knowledge. Thus co-location of cutters means that engineering support units can be located in the same area and provide a cadre

of expert mechanics capable of troubleshooting multiple ships. This cadre can also provide a training environment and shore side rotation for engineers assigned to ships. The engineers ashore often see the same problems cropping up on different ships and can quickly develop one solution and share it amongst the various ships, reducing overall repair time for equipment.

Another benefit of multiple ships being homeported together is the information exchange amongst the crews. Everything from new ideas for watch rotations to combat training scenarios, and ways to operate the ship can be routinely discussed at the gym, local club, in the wardroom, or over lunch on the mess deck. This free flow of information and knowledge enables cutters to rapidly improve conditions or solve problems they may be experiencing. The informal flow of information via face-to-face conversations makes home porting an ideal method for sharing knowledge.

This is true when conducting training as well. In 1998-1999 the Coast Guard began deploying an upgraded navigation system, SCCS-270, to some of its cutters. There were multiple cutters home ported in Portsmouth, VA capable of conducting joint training with special instructors. This reduced the number of trips the instructors had to make to units, and increased the rate at which crews could be trained.

Overall, there are numerous advantages to home porting from the knowledge management perspective, which has increased its value beyond the amount of money saved on logistics.

3. CO's Conferences

The wide geographic separation of most Coast Guard cutters, and their diverse schedules, cause face-to-face exchanges of knowledge and information to be infrequent. Due to the importance of these exchanges, the Atlantic and Pacific Area Commanders hold annual conferences for their commanding officers. The conferences provide the commanding officers an opportunity to discuss the issues of primary importance to them, and engage in question and answer sessions with each other and guest speakers. The Area Commanders use this opportunity to share important policy concerns and initiatives and pass along personal observations.

The annual conferences are preceded by a period of information gathering by the Area Commander's staff. Solicitations for topics are sent out, and returns prioritized by interest and importance. Commanding officers may solicit input from their officers and chief petty officers on topics of importance to the crew, or may opt to submit only their own topics.

During the conferences, not only are the topics on the agenda covered, but numerous sidebar discussions are held. Most CO's are peers and many have served together at prior duty stations. Stories are told and information is passed informally. Some new ideas with universal appeal will generate much discussion and follow up messages to facilitate fleet wide implementation.

Upon their return, CO's may choose to brief their crews on the many topics covered. Many CO's will bring back ideas for new programs passed along by other CO's

at the conference. They may direct the XO to implement the ideas for their cutter. Often this leads to an exchange of information between two cutters, as the crew of the cutter whose CO wishes to implement the new program contacts their counterparts on the originating cutter to find out the details of the program.

These conferences have been extremely successful ways of sharing information and knowledge, and are universally praised by CO's and staffs despite the time involved and the effort in preparing. One drawback to this forum is that not all CO's are able to attend; many are on patrol or otherwise occupied and miss the opportunity to exchange ideas. Another drawback is that there are many issues to address each year, and too little time to cover all of them.

4. Refresher Training

There are various names for the refresher training cycles that cutters operate under depending on the Area Commander and type of cutter. The goal however, is the same – to provide a training environment that allows the Area Commander and the ship's CO an opportunity to assess the ability of the cutter to perform its missions, and an opportunity to improve its training teams.

The training cycle may be a one or two year period. The cycle generally follows a pattern of: pre-inspection – to assess strengths and weaknesses; inspection/training – to reinspect weak areas and conduct training with subject matter experts; and post-inspection – correcting remaining deficiencies and conducting routine training to maintain proficiency.

The Coast Guard has developed standards for each class of cutter to measure its material and personnel readiness. The people at the training commands are the subject matter experts on these standards and act as teachers for the crews of cutters throughout the cycle. Each cutter has access to the standards and the checklists used, and are expected to refer to them frequently to maintain readiness.

Cutters are expected to form On-Board Training Teams (OBTT). These training teams are developed for each area of proficiency the cutter is measured in: Damage Control, Engineering Casualty Control, Navigation and Seamanship, and Combat Systems. It's the responsibility of the OBTT members to run drills, identify problem areas, train crewmembers, and ensure safety during exercises. Training teams maintain records of the cutters' progress and areas requiring more training.

During the Inspection part of the training cycle, the OBTTs are under review to ensure they are following correct procedures. This is also the time to ensure its members are using the latest information and knowledge in their area of expertise. Each team is trained, and provided opportunities to run drills to demonstrate proficiency.

The training cycle is an excellent means of ensuring cutters are kept at peak readiness. History has shown that cutters peak in readiness during the pre-inspection and inspection part of the cycle, and begin to taper off gradually throughout the rest of the cycle as personnel rotate, and operational issues interfere with training. Decreasing the time between cycles flattens out the readiness curve and ensures more uniform standards.

One of the greatest advantages to conducting an annual training cycle is that all personnel receive more knowledge and improve skills, thus the impact of the personnel rotation cycle is minimized as newer people are quickly brought up to the expected standards. The cutter also maintains a tighter focus on the Coast Guard standards, which ensures greater compliance.

A potential drawback to the training cycle is in how the evaluations from the inspection are used. Every cutter and commanding officer wants to achieve the highest scores possible on drill evaluations and training. This is a natural desire fostered by a healthy competition between cutters, and a desire to look the best to outside observers. This practice, however, may mean that when cutters are being graded they only place their most experienced personnel on the teams being evaluated. While this ensures a better score, it means that the people needing the training the most, the rookies, do not receive it. This is preventable in the way that the Area Commander's and CO's approach the evaluations.

5. Mentoring

Captains of ships have used mentoring throughout the ages to train young officers and crewmembers in the ways of the sea and seamanship. Today's Coast Guard has placed a strong emphasis on its mentoring program, not only for personnel on cutters, but throughout the service. Onboard cutters, crewmembers are encouraged to find a senior person who can "show them the ropes." Experienced personnel must serve as teachers and guides to train newly assigned crewmembers, and help them gain the knowledge

needed to perform their jobs unassisted. There is mutual benefit in the process. The new members gain the knowledge needed to do their jobs, and mentors reduce their workload and schedules as the new crewmembers become qualified.

Mentoring plays an indirect role in inter-cutter knowledge sharing. Crewmembers and officers mentored by senior personnel often establish strong bonds. These relationships can continue long after the people involved have been reassigned. It is not uncommon when solving problems, for a person to seek advice from old friends. As people gain more experience, and become mentors themselves, the knowledge they received is passed along to a new generation of Coastguardsmen, renewing the cycle.

B. WRITTEN COMMUNICATIONS

Shipboard electronic communications have become extremely sophisticated. Cutters at sea today have access to satellite, HF, and VHF/FM radio signals for sending messages. Ship-to-shore communication via satellite phone, while expensive, is now common. The Navy has successfully deployed high-speed Internet connections and e-mail to its battle groups; and while the Coast Guard still lags behind, it has recently begun deployment of HF e-mail systems to cutters to enable low-cost access to e-mail. Inport, cutters have the full range of communications options normally available to a modern organization.

The Coast Guard has established formal channels for communicating official correspondence and orders, as well as informal channels for quick communication working information and knowledge. The formal channels include: written

documentation, message traffic, Internet/intranet web sites, and official databases. The informal means of communication include: e-mail, and phone calls. Each of these is discussed in turn.

1. Written Documentation

Written documentation is the most formal means of communication used by the Coast Guard, and the slowest. Letters, memos, and documents are used to communicate official ideas and knowledge. Written documents are used extensively for passing along procedural knowledge and doctrine.

Cutters are required to maintain libraries of publications ranging from classified tactical manuals and equipment repair manuals, to manuals describing the proper format for administrative paperwork. These manuals have become the cornerstone of how cutters are to be operated and maintained. Personnel with questions about the correct way to operate equipment, organize the bridge watch, or land a helicopter can refer to the appropriate manuals for guidance. The training process devotes a lot of time to teaching crewmembers how to find information in these manuals, and which manual they should use.

The large number of manuals and doctrine, though valuable resources and references, require significant time and effort to maintain. Commands responsible for updating the documents expend significant effort to ensure they contain up-to-date, accurate information, and that the procedures are officially approved. Crews on cutters use annual checklists and inspections to determine whether they have the latest editions

and corrections to manuals onboard. Crewmembers must manually enter corrections and changes into publications, and discard out-of-date publications. The cost of publishing, distributing, and maintaining these manuals has led the Coast Guard to begin publishing manuals either on CD-ROMs, or on the CGDN, the Coast Guard Data Netowork (CGDN). Regardless of the format, doctrinal manuals provide the core knowledge for the official way to conduct operations and maintain cutters. They are widely studied and referenced, and contain knowledge accumulated through years of experience.

Another use of written documentation by the Coast Guard is the capture and communication of knowledge regarding serious accidents and mishaps. This knowledge is published in the form of case studies. Case studies have traditionally been used in training commands and schools to help future cutter personnel learn from previous mistakes. Typically a case study will involve only serious incidents such as groundings, fires, collisions, or other major accidents where there are enough facts to document the incident. The Coast Guard has recently begun moving the use of case studies out to the fleet by encouraging operational units to review them as part of the unit's risk management training. When combined with visual aids and group discussion, they provide an excellent forum for provoking thoughts and ideas for avoiding similar situations on the present vessel.

2. Formal Messages

Written communication, while adequate for many purposes, cannot match the speed of communication formal message traffic provides. The Coast Guard's message

system makes use of various radio and satellite channels to send highly structured text messages throughout the Coast Guard and to other branches of the armed forces. Formal messages are the primary official means of communicating between cutters and commands, often preceding other written correspondence. Messages from a command are considered to have the Commanding Officer's approval. On normal days cutters may receive over a hundred messages. This requires people, or automated systems, to screen the message traffic, sort by priority, and determine which person onboard the cutter should see each message. Messages are transmitted via radio or satellite signal, which requires brevity to reduce the load on transmission circuits. Costs and congestion on these mediums necessitate that the Coast Guard limit the volume of messages.

Messages are frequently used to share critical information between cutters, especially underway when written communication is impractical. Cutters conducting missions at sea pass critical information and knowledge to ashore commands via message traffic on a routine basis. Aside from operational knowledge and information, there are several routine messages that are designed to pass less urgent knowledge. These messages include: Lessons Learned, After Action Reports (AARs), and Safety/Mishap Messages.

a. Lessons Learned

The goal of the lessons learned process is for cutters to share good and bad experiences regarding specific operations or deployments with their chain of command and each other, to help others benefit from their experiences, and avoid repeating their mistakes. Lessons learned are usually shared by a formal message from a cutter to their

operational commander, with copies to other cutters involved in similar operations. These lessons learned are usually gathered at the end of major operations or patrols and then disseminated to the rest of the fleet as appropriate. Operational commanders and cutters keep either paper or electronic files of past lessons learned to draw from for future operational planning.

Operational commanders have specific formats for their Lessons Learned messages, which seek to elicit comments on everything from the planning and execution of the operation to the logistical support provided. Commanding Officers are also encouraged to provide additional comments on areas of interest not covered in the rest of the message. The messages are typically unclassified to encourage the widest dissemination possible. These messages are usually drafted toward the end of the cutter's assigned time in the operation or area, and are considered formal messages from the cutter's commanding officer to the operational commander.

The Lessons Learned messages provide a great opportunity to share tactics, logistics information, and feedback regarding the operation. The results are compiled and used to improve future operations and plan patrols. Classified lessons learned are generated separately if required, and distributed appropriately. While these messages have many advantages, there are also some drawbacks.

One of the chief drawbacks is their official nature. Many CO's are hesitant to place negative feedback in official writing because it will be widely reported and may serve as a source of embarrassment or trouble for another commander. Thus negative

feedback is generally handled via private conversations, or couched in vague terms forcing outsiders to read between the lines. While this may be a tactful way to handle the problem at the time, it, however, denies future observers information needed to properly evaluate the effectiveness of the operation.

Each patrol and operation generates a lot of knowledge and information, not all of which is appropriate to place in a written message. The end of a patrol or mission is generally a busy time for the crew of the cutter. When the Operations Officer begins the solicitation for lessons learned, the feedback may be limited to only the most important issues. Many of the less important issues are not included because of a desire to keep the message length reasonable, or because of their seemingly trivial nature. This process also limits contribution of ideas to a relatively small group of contributors, whose ideas are further edited by the message writer and proofreaders. This again results in an incomplete capture of knowledge associated with the operation.

Finally, information and knowledge captured via Lessons Learned messages is transmitted electronically via message traffic. These messages can either be printed and stored, or stored electronically in folders, or documents. To retrieve the messages requires a user to access written records, or search for the electronic version and then read and sort through the message for the topics of interest. Since physical space is limited on cutters, the electronic storage method is preferred. This storage method is redundant (Each user stores the messages they feel they will draw upon in the future.) and time consuming when the information is required at a later date.

Overall, despite the drawbacks with Lessons Learned messages, they serve as a vital means of communicating important information and easily documented (explicit) knowledge from cutter to operational commanders and other cutters.

b. After Action Reports

After Action Reports (AAR) are similar in nature to Lessons Learned messages and are required from cutters at the end of every patrol. They are typically submitted via message traffic to the Area Commander, with copies sent to the Operational Commander and other cutters, within ten days of a cutter's return to homeport. Standards vary from Atlantic and Pacific commands. However, the reports generally seek to capture information on the number and types of boardings and missions performed. They provide an opportunity to comment on trends spotted in the area of operations, logistics, significant casualties (equipment and personnel), and training opportunities.

AARs, being formal messages, share many of the same advantages and disadvantages as Lessons Learned messages. AARs are usually more general in nature, encompassing elements from the entire patrol instead of a specific operation, or event. AARs provide essential statistics on the number and quality of boardings and days underway for the Area Commanders' use and are good patrol summaries for sharing information on new ideas, methods, or changes to current procedures that the cutter personnel found useful during their patrol.

c. Safety/Mishap Messages

When things go wrong on board cutters and people or equipment are damaged, the Coast Guard makes every effort to share as much information as possible

through the use of official Safety and Mishap messages. Safety messages usually summarize accidents of a personal nature, which caused injury – such as a hatch slamming on a finger. Mishap messages report accidents of an operational nature, such as a cutter running aground.

Safety messages are released on a regular basis, and contain summaries of multiple incidents. The summaries are generic in nature, and do not identify the ship, or the people involved. Their purpose is to draw attention to areas on board cutters where accidents are more prone to happen and to unsafe personal behavior. Often these messages are written in a humorous style to gain readership of what might otherwise be a dry topic.

Mishap messages or reports are published after each significant incident has been review by a panel of experts. They are very specific in terms of what happened and what they believe caused the incident. The goal of the mishap message is to inform other cutter personnel about the findings so they may take steps to avoid similar mishaps. These messages contain information similar to that which might be found in a case study, but do not go into extensive narrative detail. Mishap reports often precede case studies in an effort to get information to the fleet as quickly as possible, while a more detailed study is being prepared.

The primary drawback to Safety/Mishap messages and Case Studies is the inability to delve further into the facts of the situation. Many times a reader will want to understand why a participant took the action they did, or what thought process led them to

react in a certain manner. If the writer of the message or case study did not ask that question, the reader is left in the dark. These reports are also very context specific, and the lessons must be extrapolated to other circumstances to be useful.

3. Web Sites

The Coast Guard presently has roughly 600 webmasters responsible for almost 12 gigabytes of web content on 21 servers throughout the Coast Guard (Cash and Shelton). These sites are accessible via both the CGDN, and the Internet. In many cases, when there are security concerns, or there is no need for public access, the information is maintained solely on the CGDN. The web content provided by the sites is primarily organized around the hosting unit (Cash and Shelton, 2001). To find information on travel claims, users would need to know that the CG Finance Center was responsible for the information, and then access their web site. Cutters have limited their web sites predominantly to providing information on the history of the vessel, and routine public affairs announcements.

The limited use of web sites by cutters is a result of the lack of access most cutters had to the Internet until 2000. Prior to that time cutters wishing to access the web on board did so using self-procured computers. The Standard Workstation II computers, in use until 2000, were not web enabled. Standard Workstation III computers have now been installed on all HEC/MEC cutters and allow access to the Internet. Web access is still limited to inport periods only, due to lack of access to the web once underway. This is an obstacle to cutter crews using the web to share information and knowledge.

4. Official Databases

Coast Guard cutters have long had access to official databases, used to accumulate data of law enforcement and safety interest. Crewmembers routinely provide information on vessel boardings and sighting, which are sent either via message, or e-mail in to the Operations Systems Command for input to the law enforcement database. Crews can dial-in to the database while inport and download information on sightings and vessels in their upcoming patrol area. While on patrol, they may receive updates via CD-ROM, or may call their operational commander via radio to and have the duty officer run a query on the database, should their database files be out of date.

Other official databases exist; however, the information is generally inaccessible to cutters. It has not been until recent years that efforts have been made to coordinate these sources of information and make them accessible via the CGDN. In December 2000, the Coast Guard CIO launched a web portal initiative. One of the goals of the initiative is to develop a means of linking databases to the web and allow users to access customized reports (Cash and Shelton). Without convenient access to the information contained in the databases, cutter crews have not used them as means to share knowledge within the community.

5. Informal Messages

Informal methods of communicating messages are a necessary adjunct to their formal counterparts. It is not always necessary to send formal correspondence to pass along routine, non-vital information and knowledge. Using informal channels not only speeds up information flow, but reduces expenses associated with the formal channels

and their time delays. The predominant means of informal communication amongst cutters today is e-mail and phone conversations.

a. Email

E-mail has recently become a quick way of sharing information between crewmembers on cutters. The informal nature of e-mail combined with a comparative lack of official oversight, has led many to use this medium to share ideas and knowledge. Despite the ease of sending e-mail, there are several obstacles that limit its effectiveness for knowledge sharing. The first obstacle is the lack of access to computer terminals for personnel assigned to cutters. A typical 270-foot cutter has a crew of 100 people and a computer allowance of approximately 29 workstations. Cutters may augment this allowance by purchasing additional systems, however, the critical factor for cutters is a lack of space. There is not enough room onboard a cutter to provide a standard desktop workstation for each crewmember. Senior officers and key administrative personnel each have access to a computer. Junior officers, chief petty officers, and the crew, however, each have to share access to workstations. The number of people sharing these workstations increases the lower ranking they are.

Lack of physical access is not the only obstacle to using e-mail onboard cutters. Presently, cutters at sea do not have access to the Internet, CGDN, or reliable access to standard e-mail. The Coast Guard Maintenance and Logistics Commands are deploying an e-mail system to cutters, which transmits signals over HF radios, however, it is not yet deployed on all cutters, and is subject to normal HF radio signal interference

and loss. Satellite connections are available, but are prohibitively expensive, resulting in their use for just critical communications.

A third obstacle to effective knowledge sharing via e-mail is the inability for the organization to capture this knowledge on a consistent basis. One of the phases in the knowledge management life cycle defined in Chapter II is the capture of existing knowledge. Knowledge shared by e-mail is usable by only the sender and recipient(s), and may be quickly lost once their use for it is over. This lack of openness breaks the cycle for knowledge management.

The final obstacle faced by sharing knowledge between cutters by e-mail is the lack of knowledge regarding who has the information that a crewmember may be seeking. Certainly an operations officer may wish to contact other operations officers onboard other cutters to seek advice about an upcoming mission. Perhaps, however, the most knowledgeable person regarding that particular mission has just transferred to another position. Unless the officer seeking the knowledge was aware of this fact, they would be unable to reach the best source. Thus, users of e-mail are still limited to their "local" group of acquaintances, even though that group is geographically spread out.

b. Phone Conversations

Although they are not forms of written communication, phone calls are a primary means of informal communication amongst crews on cutters. Using phone conversations to share information between cutters is neither revolutionary nor unusual.

Coastguardsmen share the same advantages and opportunities as their business counterparts in this regard, with the exception of when the cutters are at sea.

The use of satellite technology has enabled cutters at sea to place satellite linked phone calls to each other and to shore units. While expensive, this provides a quick means of sharing information and knowledge. Due to the expense, however, it is only used in situations when speed of communication is important. Many cutters limit access to the satellite phones by placing restrictions on the types of calls that may be placed, and requiring users to seek permission from senior supervisors. These limits inhibit the transfer of all but the most important information and knowledge.

C. SUMMARY

The current knowledge management practices for the HEC/MEC community are rooted in the traditional methods for sharing information: personal contact and written documentation. These methods are reliable and do not require extensive technology to implement. Technology has not been fully embraced for the sharing of knowledge within the community. Certainly advances in radio communications have improved their reliability, just as computers have been used to automate the drafting and processing of message traffic. There have been no revolutionary changes, however, in the means for communicating and sharing knowledge among units.

The Coast Guard has recently taken steps to lay the groundwork for implementing changes to the way knowledge is managed. These steps include standardizing the computer systems, and launching the CIO's initiative for a web portal to make databases

accessible via the CGDN. Technology alone will not change the way Coastguardsmen share knowledge. To accomplish this will require a new knowledge management architecture.

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IV. HEC/MEC KM ARCHITECTURAL DESIGN

The Coast Guard's knowledge management practices outlined in Chapter III are based predominantly on written and personal communications. Despite the increased speeds and reliability of transmitting the written word, there has not been a major shift in the manner in which ideas and knowledge are shared. This chapter examines the limitations of the current practices and suggests a new architecture, including technologies, for managing knowledge. Finally, recommendations for implementing a KM revolution within the HEC/MEC community are presented.

A. LIMITATIONS OF CURRENT DESIGN

The practices outlined in Chapter III have many strengths and some weaknesses. When reviewed in light of the knowledge management life cycle presented in Chapter II, several limitations are apparent. These limits include: cultural barriers to knowledge creation, limited communities of practice, restricted awareness of available resources, and limited access to the knowledge life cycle.

1. Cultural Barriers

The first limitation is a cultural barrier to the transfer of knowledge, a byproduct of the command culture discussed in Chapter II. The command culture onboard cutters emphasizes use of the chain-of-command to pass information and ideas throughout the ship and to other commands. The chain-of-command can be a great method to refine ideas. Junior personnel, in many cases, may lack the language skills, or corporate

knowledge necessary to communicate the merits of their idea beyond their local environment. Their supervisors can help refine the idea and send it on to the next level of the organization for consideration. Sometimes, however, this turns into a screening process, where only ideas of interest to the supervisor are forwarded.

People at higher levels in the chain-of-command are there, in part, because of their experience. They may have seen many ideas, similar to those being presented, in the past. If these ideas previously met with disapproval, or failure, they will be less inclined to endorse or forward them with the same zeal as a fresh idea. But, as stated by Hamel (1996), "experience is valuable only to the extent that the future is like the past." Modern organizations are undergoing so many changes that old experiences are becoming irrelevant. Eliminating some of the new ideas before they can be properly aired may lead junior personnel to question whether their insights and contributions to the organization are valued.

An anonymous Coast Guard officer sent a letter to the editor of the Coast Guard Academy Alumni Bulletin in April 2000 stating, "When your chain of command fails to support you often enough, you eventually learn that it does you no good to stand up for what is right or to demonstrate passion for your job. Your passion is killed." (Wilczynski, 2000) Indeed, Hamel points out that:

> All too often, however, there is no process that lets those revolutionaries be heard. The layers of cautious bureaucrats who separate them from senior managers muffle their voices. They are isolated and impotent, disconnected from others who share their passions. So, like economic refugees seeking greater opportunity in new lands, industry revolutionaries

> often abandon their employers to find more imaginative sponsors. (Hamel, 1996)

The perception that the chain of command is stifling the flow of information and knowledge is difficult to dispel, even onboard the best cutters. Two way communications and trust are required to counter this perception. People need to understand why their suggestion was rejected, altered, or delayed (Von Krogh, et.al., 2000). Sometimes this communication breaks down. Cutters are extremely busy inport and underway, and many times good ideas are ignored, or forgotten, not due to malicious intent, but because operational requirements consume the attention of the senior leaders until the ideas are forgotten, or their sponsors grow tired of waiting.

2. Limited Communities of Practice

Coastguardsmen assigned to cutters are limited by geographic and communication constraints to interaction primarily within their local communities. Local communities refer to other personnel assigned to the cutter, to nearby cutters, or to shore units, or to professional contacts throughout the Coast Guard. These limitations are not regulated, but a result of limited knowledge of who to turn to for assistance on projects. The size of this community expands as Coastguardsmen rise in rank, gain greater organizational knowledge, and increase their professional contacts. Rarely, however, is it possible for an individual to become acquainted with every professional who may be able to contribute knowledge to a particular project.

The HEC/MEC community is widely dispersed across many time zones. Members of the community may be homeported anywhere from Hawaii, to Maine, or to Florida.

Cutters assigned to the Pacific Area Commander rarely interact with cutters assigned to the Atlantic Area Commander. Even within the Atlantic Area, 270's from Boston may have infrequent contact with their counterparts in Portsmouth, VA. Unless crewmembers meet at conferences, training, or during a common mission, they are largely unaware of what their counterparts are working on.

A new ensign, for example, assigned duties as Educational Services Officer (ESO) may be limited, geographically and by lack of experience, to the resources provided through his chain-of-command. During the turnover process, his relief may have provided official points of contact for answering procedural questions over the phone or using e-mail. His supervisor will also provide advice when asked. The officer may even have other cutters nearby that have ESO's with whom to converse. Overall, though, he will be isolated from reaching ESO's assigned outside the immediate geographic area. Time and energy will also be required for this officer to establish good relationships with official points of contact, and other ESO's before the flow of information and knowledge becomes a comfortable two-way exchange.

These limits apply equally to any position onboard the cutter. A Commanding Officer will have more resources and acquaintances with whom to work, but is still constrained by communications channels and geography. The new Food Services specialist who reports aboard is further constrained by more limited access to communications than, for example, the CO. The ESO may judge that he has a great solution for the problem of too many exams being compromised during distribution from

the Coast Guard Institute to cutters. Yet he may not have a network of fellow ESO's or personnel with experience in exam distribution to help refine this idea so it draws the attention of people who can make changes.

The communications available (e.g., messages, e-mail, personal contact) do not ensure that everyone with an interest in a community's project will be notified. Messages are typically limited to issues that have a high level of interest and are not suited for brainstorming. Finally, e-mail and messages are not always addressed to all parties interested in a project.

The limitations of geography and communications serve to inhibit growth of professional social circles and reduce interaction within a Coastguardsman's community of practice. Failing to know whom to contact, or being limited by physical separation can severely limit the free flow of knowledge and information around the community.

3. Restricted Awareness of Available Resources

Another limit to the free flow of knowledge within the cutter community is the restricted awareness of resources available to solve problems. In 1998 a new Engineer Officer (EO) reported aboard a 270' cutter homeported in Portsmouth, VA. This officer had recently come from an assignment at the Maintenance and Logistics Command, Atlantic (MLC-A), in Norfolk, VA – a fifteen-minute drive away. Because this officer knew what resources were available, he was able to immediately correct ongoing maintenance issues on the cutter, saving time and money in the process. The resources

had been available to the previous EO, just fifteen minutes away, yet because he was not aware of what could be done for him, he never used them.

Support commands are eager to perform their mission and assist cutters. Yet keeping cutters aware of their abilities is difficult. Many commands use written memos, or messages to provide lists of services and points of contact. Paper and electronic phone directories are also published and distributed Coast Guard wide. However, unless a person is working on an issue requiring the support being advertised, the information will be filed. When a situation arises where they need that point of contact, the user must first recall they have the information, then where they placed it. This assumes it wasn't their predecessor who filed it, in which case they may not even be aware the resource is available.

Many of the services available are organized by command rather than by resource or topic. Coast Guard web sites, as mentioned in Chapter III, are organized this way. Users must know which office in the Coast Guard handles an issue before they can access the correct directory, or web site to look for the information.

This problem can be exaggerated when a command begins working on a new project, or idea. These new projects or services may not be advertised to consumers, or other units, until they are near completion, or a probability of success has been determined. In some cases, crewmembers on ships have developed innovative improvements to a shipboard process, only to find that other cutters, or support commands had been working on exactly the same project. Instead of combining resources

and developing a solution, the personnel had worked separately, and now possessed competing proposals.

The restricted awareness of resources continues to be a problem despite the increase in communication via phone and e-mail. Unless users are aware of the resources available to them, they will not know to ask about projects, or request services. With the frequent turnover of personnel, many resources and contacts may be inadvertently lost or forgotten, and never passed along. There is a tremendous amount of knowledge and resources available to the personnel assigned to cutters; they simply need to know where to look.

4. Limited Access to the Knowledge Cycle

Knowing where to look for knowledge is not enough if your access to the knowledge is limited. Access for cutter personnel is limited by difficulties in receiving the knowledge, especially while underway. Cutters averaging 180 days away from homeport per year are hard pressed to participate in knowledge creation processes and to maintain open distribution channels.

While underway, it is very difficult for personnel on cutters to participate in CO's conferences, project teams, meetings, and training activities. Cutter XO's must carefully balance the desire to send crewmembers to formal training schools to obtain knowledge for their jobs, versus the need to keep the member on the cutter to perform the mission. The restricted access in these situations hampers the ability of cutter personnel to participate in the knowledge creation process.

Once away from the pier access to e-mail, web sites, mail, and phone conversations becomes extremely limited. Cutters rely primarily on message traffic when at sea. Mail is routinely delivered to cutters at logistics stops, but there is no guarantee of speedy delivery. The disrupted lines of communication negatively impact the ability of cutter personnel to receive and distribute knowledge. Denying cutters access to informal communications channels means that all informal knowledge creating, sharing, and capture, external to the cutter, is eliminated. The only participation that the crew has with the rest of the HEC/MEC community and the Coast Guard is via formal message traffic, and radio communications.

Limited communications mean that the new methods and knowledge generated by cutters underway must often wait to be shared until the cutter arrives back at homeport and generates their AAR. Should they happen to share the information by message while still at sea, personnel reading the message and desiring further information, must either wait for the cutter's return, or request feedback via message. All of these delays and obstacles in the means of access to knowledge and its distribution only serve to limit the participation of cutter personnel in the knowledge management life cycle.

The limitations of the HEC/MEC community's current knowledge management practices are, in part, a product of unawareness of the concept of managing knowledge. In the past technology did not exist to overcome many of these obstacles. This is particularly true regarding the efforts to capture informal knowledge. Today's technology, though, offers quicker means of sharing knowledge, and creative ways to capture some of the

informal and tacit knowledge that previously eluded conventional forms of knowledge capture. The Coast Guard, however, has been lagging behind in applying this technology to its business practices. The 1998 U.S. Coast Guard Information Technology Management Strategy noted that the Coast Guard had failed to merge the use of modern information technology (IT) with its business processes, organization, and infrastructure. The Coast Guard's vision for IT Management is, "The Coast Guard, as the world's premier maritime service, delivers the right information to the right people at the right time to support all Coast Guard missions." For the HEC/MEC community and the Coast Guard to achieve this vision in the knowledge management will require it to embrace a new architecture.

B. A NEW KM ARCHITECTURE

The objective for new knowledge management architecture within the Coast Guard is to build on current strengths, and overcome the current limitations. This is recognition that there is important expertise and experience that must be preserved and used to its fullest advantage. The architecture identifies the scope for the investment that will be made in managing knowledge (Applehans, et.al., 1999). Accomplishing this within the cutter community means improving the access to explicit knowledge captured in its manuals and doctrine; breaking down barriers to rapid sharing of new ideas; expanding the communities of practice and participation in these communities; making resources easy to find; and finally, giving personnel on cutters the ability to connect and to participate fully in the knowledge life cycle, no matter where they are.

Designing an architecture to meet these high criteria for the Coast Guard and the HEC/MEC community requires a bottom-up review of the modules of such a system, and how they relate to the knowledge management life cycle. Figure 4.1 illustrates the modules of a Coast Guard knowledge management architecture or base. Each of the top five modules is designed to work together to provide a balanced KM approach. Some aspects of the knowledge life cycle can be mapped directly to individual modules, other phases span modules, and finally, some phases, as in the case of Evolve, are difficult to link directly to a technology solution.

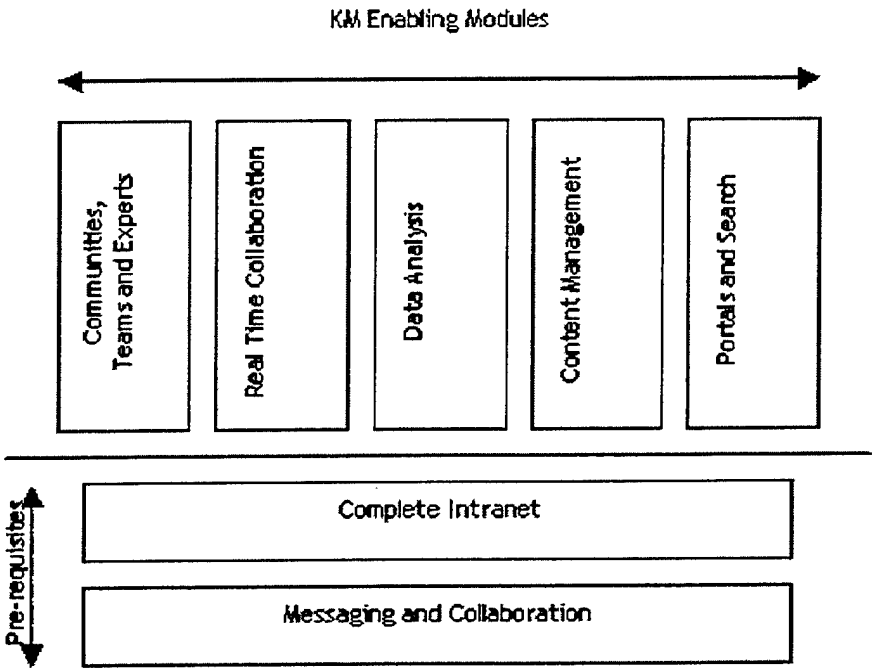

Figure 4.1 – The Modules of a KM Architecture (From Liebman, 1999)

The basic modules of this architecture – Communities, Teams and Experts; Real Time Collaboration; Data Analysis; Content Management; and Portals and Search - are built upon two essential pre-requisites. These pre-requisites are: a system for messaging

and collaboration; and a complete intranet. This foundation provides an infrastructure that supports the efficient transport, structure, access, and collaborative management of electronic data (Liebman, 1999). Overall, each of the KM modules must be blended into a cohesive unit whose main purpose is to understand the important content necessary to meet organizational objectives, and to provide a means to accomplish this task.

1. Messaging and Collaboration

The goal of the knowledge management system is to provide an environment, which fosters the creation, sharing and reuse of knowledge. Knowledge workers will need a set of common, easy to use services, capable of rapidly transmitting e-mail and documents to achieve this goal. These intuitive tools serve to motivate knowledge workers to participate in document and knowledge exchange by removing physical and technological barriers. When these barriers are removed the flow of knowledge will increase, and the burden of capturing the knowledge decreases.

The Coast Guard, by completing the migration of all cutters to Standard Workstation III, has established a common collaborative environment based upon the Microsoft Office suite of tools. This migration has eliminated a standardization bottleneck and provided the foundation upon which to expand the other modules of the knowledge management architecture.

2. Complete Intranet

Technology for widespread information use must be common, easily used, and most important, interconnectible (Marazzo and Connolly, 1999). Interconnectibility gives users the opportunity to find the right information or sources for helping solve problems

and drive decisions (Liebman, 1999). At present, the best way to accomplish this goal is to have an organization-wide intranet. Simply linking each unit within the organization together on an intranet, though, is not enough. Workers, to be effective, must know which group or team within the organization needs what kind of knowledge. They must also know, or be able to find out, where information inside and outside the organization is located.

Intranets must be well organized and include knowledge maps to assist workers in locating and using knowledge. Maps assist users in understanding where the knowledge they require is located and how to obtain it. Knowledge maps must be regularly updated, and easy to access via a user's web browser. Keeping the map updated is a role allocated to knowledge analysts, or librarians.

The knowledge analyst is responsible for assessing the critical information needs of key end-users and assembling resources to meet those needs (Applehans, et.al., 1999). Knowledge analysts negotiate between groups and handle overlapping competencies and border issues so as to optimize the information gathering process (Liebman, 1999).

Completing the Coast Guard Data Network, and organizing the knowledge found there, is a top priority for developing a new KM architecture. Though a majority of units (with the exception of minor detachments, or personnel assigned to other service branches) have access to the CGDN, cutters underway do not. Cutters can no longer afford to be cut off from normal communications. Cutters on patrol generate large amounts of knowledge (e.g., operational intelligence, equipment performance, weather

patterns, etc.). Not including them in the knowledge life cycle is depriving the organization of timely new knowledge and interaction.

Complete connectivity would provide many opportunities to improve knowledge management processes such as requesting Statements of No Objection (SNO) to board, or seize suspect vessels. Decision makers, instead of relying on voice communications and written message traffic alone, could have quick, reliable access to first hand information. Cutters, connected to the CGDN, could stream video of a suspect vessel taken from their helicopter or boarding team, directly back to the operational commander. The video stream, combined with computer input from the cutter's navigation computers and voice relays from the CO, or operations officer, would provide a clearer picture of what is taking place. This ability to quickly put front-line information and knowledge into the hands of decision makers would reduce time required to accurately process SNOs. Reengineering processes of this type would be feasible with high-speed data network connections to cutters.

Establishing a complete CGDN is not a simple task. Cutters do not typically sail in battlegroups where economies of scale are possible. Cutters are often deployed to remote areas of the globe beyond much of the normal satellite coverage. The decision to pursue a high-bandwidth connection for each cutter at sea will entail significant cost in acquisition, operation, and maintenance. Another hurdle which increased dependence on the CGDN would bring is the need for a Network Operations Center (NOC).

The CGDN has developed over the past decade much like the Internet, one server at a time. When units required connection to the CGDN, a new physical conduit, and possibly a server, was installed. As the CGDN has grown and traffic increased, it becomes harder to efficiently manage such a system with the limited network utilities available on individual servers. Using the CGDN as the backbone for a KM architecture will make this task impossible without the additional diagnostic and maintenance capabilities of a NOC.

Finally, in addition to the expense of sending the CGDN to sea and deploying a NOC, the Coast Guard must move forward with its plans to reorganize web content. Combined with its established messaging and collaboration system, a complete CGDN will give the Coast Guard the opportunity to begin building the additional knowledge management modules necessary to complete the knowledge management evolution.

3. Communities, Teams, and Experts

The next step in the development of the knowledge architecture is the development of virtual communities, teams, and experts focused on creating new knowledge and turning existing knowledge into results. Communities and teams differ in their levels of participation and the completeness of the knowledge with which they work. Teams, which are generally task driven, work closely together on a specific project. Communities, drawn together by common interests, usually share more refined knowledge (Liebman, 1999). Experts should be seen as the moderators and judges for knowledge developed by the teams and communities. Each is discussed in turn.

a. Virtual Communities

Online communities share many aspects of their traditional counterparts. They form around a shared purpose. They are created by people who come together to accomplish, or learn something that they could not do alone (Mieszkowski, 2000). Attempting to build a community without a compelling reason or sense of purpose will fail. Online communities may lack the physical interaction and visual cues of regular communities, but they are still purpose and issue driven.

It is harder to develop a sense of trust and identity for online members without the personal relationships involved in traditional communities. Persistent identities are needed to allow people to work collaboratively. Communities must decide what type of information is important to establish these identities. A community dedicated to helping junior officers improve their ship-handling skills, for example, might not care about a person's name and rank. Instead, information such as the amount of experience a person has on ships, the type of ships they have driven, and what they consider their strengths to be, becomes important.

A persistent identity allows the person to establish a reputation. Reputation is based on what the person does, says, and the quality of the knowledge shared. Other people begin to judge a person's contributions in light of their reputation (Mieszkowski, 2000). This is evident in an unofficial community for Coast Guard personnel, Fred's Place (www.fredsplace.org). Recently, a member posted a new message trying to encourage discussion on a sensitive issue. This member had apparently posted similar

messages in the past with inflammatory comments and no substance to support his claims. Therefore, other members chose to ignore the new posting and commented that it was in poor taste. This member found out that reputation matters because other members of the community used it to make judgments about his intentions.

Reputation within the community can also become a status symbol. Members will work to maintain, or build a good reputation by posting quality answers to questions, or publishing good material. This is an incentive to continue contributing. Communities such as eBay provide rating symbols next to members' names to signify the quality of their contributions. If a community has a way of awarding status that is visible to other members, people will strive to achieve it (Mieszkowski, 2000). This will keep them coming back and encourage others to build their own reputations.

Finally, communities must have standards to regulate behavior and establish boundaries. There may be criteria to join the community. For example, Commanding Officers may establish an online community to discuss command issues. They would establish that only CO's, former CO's, or prospective CO's could join. This might allow for a freer discussion on issues than would be possible if membership were open to everyone. A moderator, or person in charge of maintaining the site usually enforces the community standards.

There are a wide variety of web development tools available for hosting online communities. Most communities host their own web sites, running discussion boards, forums, resource files, and information pages. Maintaining a list of these

communities and their resources in the online knowledge map is essential for members to be able access those of interest to them.

Building effective communities is an important way to ensure that personnel separated by geography, time zones, or other physical barriers have an opportunity to come together and share experience and knowledge. This would allow personnel on cutters to share knowledge on an informal level with their counterparts around the world. Conducting the knowledge sharing in an online forum allows the Coast Guard to capture, filter, and reuse it as needed in the future.

b. Virtual Teams

Virtual teams differ from communities not only in size, but in the way they are formed. Teams are built to tackle specific issues or problems. Traditional teams can receive a formal charter designating membership, mission, and time frame. Virtual teams can be established in the same manner, or can form on an ad hoc basis by members of a community to solve a local issue.

Regardless of how the teams form they will need an environment in which to work and collaborate. Many companies currently rely on Lotus Notes®, or similar groupware to facilitate document sharing and virtual white boarding. Recently, with the explosion in peer-to-peer technology, new tools such as Groove® (www.groove.net) are moving to the forefront. Peer-to-peer, and Groove® in particular, allow team members to meet online and share a virtual workspace. Team members can see the same document being edited, or draw on a shared whiteboard at the same time they are talking to each

other using their computers. The team workspace can share just about any type of file used on computers, and is available to all members.

Peer-to-peer offers the advantage of eliminating many of the expensive servers from the network, and allowing members to set up their teams without assistance from system administrators. Teams form as they are needed and tackle the project with which they are involved. When their work is completed, the documentation and discussion threads can be saved and transferred back to the main knowledge base.

This technology allows teams to form anywhere to tackle any type of problem. Breaking down the traditional barriers frees all members of the organization to participate. Members of the HEC/MEC community are often excluded from many teams or have their participation limited due to time spent away from homeport. Developing this module may enable them to return to the full cycle of knowledge creation and sharing.

c. Experts

Experts serve to validate and filter information and knowledge generated by communities or teams. Experts can either be assigned by the organization to monitor community discussions, or can naturally occur within the community, as participants become known for their high level of knowledge on the subject of interest. Experts play a vital role in the community, by helping classify contributions as "useful," or "questionable," and helping to ensure that unproven, or improbable allegations are labeled as such. This screening process maximizes credibility for the community, and assists the knowledge analysts in properly sorting and categorizing topics.

Knowledge analysts and experts need to work close together to establish the most efficient categories and screening processes for the knowledge generated within the communities and teams. The subject matter experts (SME) can also work with group moderators to determine how long knowledge remains on the forums before it is moved to more permanent archives.

Each community develops and evaluates its own experts in addition to the ones assigned. The online motorcycle forum www.f650.com, for example, has several members who have extensive experience riding and repairing motorcycles. Other members frequently comment that the topics of discussion do not feel complete until these experts have added their comments. This does not mean the experts are always correct, or go unchallenged. Occasionally a new member will make a better diagnosis for a problem, and prove the experts wrong. This is a challenge that can result in the evolution or replacement of the community's knowledge.

Experts develop their own reputations within communities and teams just like any other member. Expert opinions are open to challenge and rebuttal. Done properly, this will result in an evolution of the organization's knowledge. Experts offer a vital service to communities and teams and are essential to the smooth operation of the knowledge management system.

d. Summary

Virtual communities and teams play critical roles in revolutionizing the Coast Guard's knowledge management process. Online communities remove many of the

barriers to the free flow of knowledge and ideas. A community may make it possible for a new recruit to go online and contribute to a forum on leadership without fear of reprisal or harassment. It may enable him to share views that otherwise might never be heard. People at sea can now participate in teams and decisions being made that affect their future in the Coast Guard. The entire nature of this process empowers Coast Guard personnel to share at a higher level than was previously possible. This flow of knowledge benefits all levels of the organization.

Senior leaders should be able to use the informal knowledge captured by the system to evaluate programs and react to initiatives. Key policy makers can be exposed to thinking taking place at the periphery of the Coast Guard. Hamel (1996) notes, "The capacity for strategic innovation increases proportionately with each mile you move away from headquarters." This system gives the Coast Guard the opportunity to capture that thinking no matter where it takes place.

Virtual communities may be perceived as threatening to some. Problems may no longer be hidden beneath layers of bureaucracy. Commanders may have less time to deal with issues before outsiders become aware of the problem. These are all legitimate fears. They need to be addressed in the process of changing the Coast Guard's culture to move it toward accepting higher levels of knowledge sharing and the subsequent benefits.

4. Real Time Collaboration

Despite the many advantages of large groups of individuals sharing knowledge in communities, the best virtual community still cannot compete with personal interaction

for sharing and transfer of tacit knowledge. Communities, and even teams to a large extent, are dealing with documents and relatively slow, threaded, conversations in online forums. To help capture tacit knowledge in the virtual environment and enhance the abilities of the extended organization to facilitate more conversations requires real time collaboration. Real time collaboration can take the form of online chat sessions, video conferencing, or an online presentation that combines video with chat (Liebman, 1999).

The simplest method to implement is the online chat service. Chat services allow meetings, with interested parties and experts, to be scheduled online. The chat sessions, while not as fast as a meetings held in person, offer the opportunity for a free exchange of ideas, questions and knowledge. The transcript for a chat session is easily captured by the computer system, and archived for access by persons unable to attend the session.

Video conferencing, though more complex, follows the same concept. Live meetings, or talks can be recorded, stored digitally, and archived in the knowledge management system. Adding descriptors, or data tags, to the video stream allows for easy search and retrieval. Storing live speeches and training sessions, though less interactive, can provide personnel, unable to attend, an experience which may be enhanced by actually seeing and hearing the presenter, versus simply reading a transcript.

Combining chat and video services into an integrated presentation can greatly enhance both experiences. In this situation, the audience receives the video, audio, and slides of the presentation on their computer desktop. The chat service is then integrated as a separate area on the desktop, and enables the audience to type questions during the

meeting. The presenter is then able to address each question, or topic during, or at the end of the presentation (Liebman, 1999). All three sources, the video, audio, and chat can then be stored and linked together for later retrieval. Real time events now become available via the intranet, or may be distributed to employees via CD-ROM, broadening the audience for each event.

Real-Time Collaboration provides support for sharing the creating process, and making it possible for knowledge workers separated by distance to come together to share. Combining this module with the Communities, Teams, and Experts module offers a wide variety of opportunities for workers to share and create knowledge in the virtual environment.

5. Data Analysis

A well-organized knowledge network is essential for encouraging worker participation and maximizing the benefits of that use. Knowledge analysts play a critical role in organizing the data and experts assist with verifying and filtering the knowledge. Despite these efforts, however, it is necessary to monitor the knowledge stored within the network to validate usefulness. Knowledge which is not used, or which is outdated, should be removed from the system to prevent users from receiving irrelevant feedback to requests. The challenge for the Data Analysis module is to understand how the users of the system interact with the knowledge base and to tailor the system to best meet their needs (Liebman, 1999).

Identifying content that is not valuable to users is just as important as making them aware of the useful content. This requires tracking the number of times users access documents and knowledge, and soliciting feedback on how they rated its usefulness. Ratings and comments should then be available to other users as well as administrators to help determine which documents are worth using.

Once knowledge documents are identified as receiving poor feedback, or low access rates they can be reviewed by knowledge analysts and purged from the active knowledge base. Knowledge purged from the system should then be archived for historical purposes. Successfully keeping the content fresh and relevant will ensure the system is viewed as up to date, and encourage frequent use.

6. Content Management

Publishing new knowledge information is essential for maximizing the quality and usefulness of the system. Getting the knowledge documents and artifacts into the system, however, can be a challenge. The system must be simple enough to allow users to freely contribute knowledge without being over-burdened by technology. Users encountering technical barriers will stop participating in the system, defeating the purpose of the KM architecture.

To make the posting of knowledge as easy as possible, the system need to rely on automated submission forms, and pre-defined meta-data to reduce user decisions, and to maintain consistent naming conventions. Users would publish documents to the knowledge system from their desktop interface. Selecting the publish option would

trigger the system to provide a form listing available meta-data tags, or categorizations, for the document. The user selects the appropriate tags and completes the form describing the document, and then submits the document to the system. After submission the system verifies that correct tags were used and stores the document.

Choosing the correct meta-tag is essential for proper categorization of the documents. Sophisticated systems, tied to Active Server Pages, or similar technology, could assign meta-tags dynamically. This would further remove the user from the process and eliminate confusion and opportunity for error. There is a danger, however, of improper interpretation and categorization on the part of the system, which would then require human intervention to correct.

Documents can be accessed using a similar process. The user conducts a search of desired categories and the system retrieves documents with the appropriate meta-tags. Search algorithms could include key word searches, free text queries, or search by document type and category.

7. Portals and Search

Most knowledge workers have accessed the Internet via a commercial portal service such as AOL, Yahoo!, MSN, or Earthlink. These services provide easy access and information which can be custom tailored to user preferences. These browsing and search services bring the vast wealth of the Internet to the user in a relatively easy to use format. Applying this format to an organization's intranet is one of the key KM enabling modules (Liebman, 1999).

Knowledge portals take an organization's information and knowledge, and make it available to internal workers, and external suppliers. By providing relevant information at the click of a button, the portal is making the complexities of the knowledge management system transparent to the end users and fostering greater participation.

For such a portal to be successful, the knowledge in the KM system must not only be relevant, but well organized and managed. The business processes for the organization must be well defined and broken down into categories to facilitate the creation of meta-tags used in the Content Management module.

While the ability to search is essential to a good portal service, the real strength of a knowledge portal is the ability to personalize the content delivered to the desktop. Personalization allows users to enter topics, areas of interest, or other criteria into the system. The knowledge management system then uses user profiles to monitor available resources and notify them of new content, or events matching the profiles. The notification, or "knowledge push", frees the user from constantly searching for knowledge sources. It permits automated monitoring of communities and teams for new threads and topics of interest.

Where commercial portals offer the latest weather, news, and sports scores, the business portal will provide updates on team status, community happenings, and the findings of the latest research project, complete with the e-mail addresses for the personnel involved. Relying on personalized, or customized content pushed directly to the user desktop can limit the user's interaction with more in-depth resources. There is no

technical solution to this issue. Making the system easy to use and navigate should alleviate some of the barriers to going beyond the first screen in the system. Knowledge-push truly makes the organization's portal a doorway to the technology in the knowledge management system.

8. Security

The knowledge management architecture developed in this section provides an opportunity to expand knowledge sharing and organizational experience. Knowledge is a powerful and considerable asset both to the Coast Guard, and its adversaries. The knowledge management system's level of classification will be the same as the current level for the CGDN, For Official Use Only. Information classified at the Confidential level, or higher would be maintained on secure computing systems. The goal of expanding the ability to share knowledge presents several challenges in light of security restrictions.

The first challenge is granting users increased access to the system outside the traditional workspace. Not every employee can be logged into a terminal connected directly to the CGDN. Many will need access from portable computers, home workstations, and handheld wireless devices. User authentication is currently done through using tokens. This approach, while extremely secure, greatly limits the number of remote users, and increases the difficulty in accessing the system. Banking and other commercial companies to protect sensitive information have used authentication

employing improved public key encryption methods, or secure socket layers, successfully. These methods offer potential for the Coast Guard as well.

Implementing a classified KM system presents an even greater challenge. The U.S. Navy currently uses the SIPRNET to pass classified information. The Coast Guard can use a similar approach. Access to this network, however, would be much more restrictive, and thus, is of limited use to the Coast Guard as a whole for knowledge sharing.

9. Additional Technology to Support the KM Architecture

The architectural design proposed above is supportable with extant technology. There are many pieces currently in place within the Coast Guard today, including web servers, collaboration and messaging software, and databases. The Coast Guard is presently working on the Coast Guard Information (CGINFO) system. The goal is to consolidate 74 separate legacy databases into a single data warehouse, and provide access to this data for multiple staff and operational units (Cash, 2001). Using COGNOS® Powerplay Web OLAP as a front-end interface, CGINFO will provide users with unparalleled access to previously stove piped information.

In addition to data warehouse and OLAP tools, the Coast Guard has contracted with Broadvision (www.broadvision.com) to provide a Coast Guard portal to the CGDN. The portal will make searching the CGDN easier and provide users with a standard interface. Adding personalized knowledge management features to this portal would help

complete the knowledge management module, and move the Coast Guard closer to the full KM architecture.

The technologies to implement the architecture exist, and the Coast Guard's IT Management Strategy (1998) has already identified the development of, "effective, collaborative enterprise-wide decision making processes," as one of its goals. It should be no surprise therefore that the technology is being assembled.

C. MANAGING THE KM TRANSFORMATION

Change on this order of magnitude is disruptive. The Coast Guard is currently feeling the effects of reduced budgets and manpower within the cutter community in terms of fewer underway days for cutters, and longer work hours for crews. The Coast Guard's missions have remained the same, yet it is attempting to accomplish them with fewer resources. Leveraging the power of knowledge has never been more important. The changes proposed for the Coast Guard's HEC/MEC community are significant. To take advantage of the power that properly managed knowledge can bring to the Coast Guard will require changes not only in technology, but also in the way workers think, operate, and are rewarded.

Changes of this magnitude will encounter opposition. Opponents may cite budget constraints, or argue the need for expanding the CGDN to cutters at sea. There are many barriers that will need to be overcome. To meet these challenges the Coast Guard must follow the steps outlined earlier for overcoming obstacles to change: Mobilize

Commitment; Develop a Shared Vision; Foster Consensus; Spread Revitalization, and Institutionalize Revitalization. These steps are related to the propose architecture in turn.

1. Mobilize Commitment

Getting the cooperation necessary for a change process of this magnitude to succeed requires a sense of urgency within the Coast Guard. Failing to generate this urgency will make it difficult to interest people in solving the problem, or to put together a team with enough power and credibility to guide the effort (Kotter, 1996). This urgency can be built by examining current business processes within the Cutter community and identifying inefficiencies and problems, which can be resolved through knowledge management.

Many of the extant knowledge management practices have been reviewed above in a general fashion. Building the momentum required to begin the change, however, requires that specific processes (e.g., supply chain management, casualty reporting, educational testing services) be examined. The team must illustrate how these processes can be improved, and the types of savings that can be achieved. Caution must be exercised not to overstate the degree of the problems, or the ability of the knowledge management system to correct them. Once enough information and data has been collected and disseminated throughout HEC/MEC community and staff units, a team, or guiding coalition must be assembled to lead the change.

The KM team should be responsible for guiding the change process. Team members should include well respected, experienced members of the HEC/MEC and

technology communities. These members should have the positional power to drive through issues of importance to the team. Strong leadership is required to build trust, and maintain the team's focus as they proceed through the subsequent steps of the plan.

2. Develop a Shared Vision

Once a strong KM team has been established it needs to begin work on the knowledge management vision. The KM vision provides a picture of how knowledge will be used in the HEC/MEC community once the change is completed. It clarifies the direction the Coast Guard is headed, and coordinates the actions of involved personnel (Kotter, 1996).

The knowledge vision must be easily understandable by the average Coast Guard worker. It should provide them with a clear picture of the benefits and feasibility of making knowledge management work. This will enable workers to envision what their roles will be like when the change is complete. Employees will still have questions at this point, and it will be necessary for the team to address them.

The KM team needs to communicate the vision whenever and wherever possible, engaging in a two-way dialogue with service members. This dialogue not only helps ease fears, but provide the team with critical feedback on their vision and strategy. The Coast Guard must begin reflecting the characteristics of the KM vision in other aspects of its work as well, to avoid the appearance of inconsistency, or undermining the effort to change. Senior leadership within the HEC/MEC community (e.g., Operational Commanders, MLC senior staff, and cutter CO's), needs to be committed to the vision.

3. Foster Consensus

Aligning service members to the KM vision can bring out a desire and expectation that it will quickly be put into action. A KM vision of empowering personnel at all levels to share ideas will fade quickly if layers of middle-management second-guess and criticize ideas and plans put forth by their workers. At this stage, unaligned structures within the community must be identified and removed (Kotter, 1996).

Removing unaligned structures and individuals may mean confronting supervisors or individuals who undercut the change. Not everyone may be initially committed to the success of the program, but those taking steps to thwart it need to be identified. Identifying and confronting uncommitted personnel may shed valuable insight into objections harbored by other workers within the community that need to be addressed. Giving these people a chance to voice their objections will bring them to light, and even if the KM team does not act on them, it shows the community that the team is serious about maintaining a dialogue. Other structures which block the change might include outdated phone systems, limited bandwidth in data lines, or other systems and processes which need to be corrected before the vision can be fully implemented.

4. Spread Revitalization

Spreading the change within the community requires achieving some short-term wins. Identifying business processes that can be improved in a short period of time with a high probability of success and pay off can help build the momentum needed to tackle tougher projects. Creating wins provides feedback regarding the validity of the vision and plan. It also generates enthusiasm among employees, and a desire to see more change take

place. Building momentum may make it easier to silence cynics and receive additional support from sponsors.

Wins encourage other employees to begin thinking in non-traditional terms about how the knowledge management system can be used to improve their business processes. They may be eager to become part of the success story. Local successes must be rewarded and trumpeted across the HEC/MEC community. Not only may others want to implement similar projects, but it may encourage them to step out and take more risks to achieve their own wins.

The KM team needs to exert leadership at this stage to keep the project focused. Avoiding fragmentation and keeping the change headed in the direction of the KM vision is critical to ensure the whole project is not ended too soon. Many success stories could provide knowledge workers with a sense of complacency. This complacency, if widespread, could cause a loss of interest as people move on to other, more critical, problems. Failure to spread the change throughout the entire HEC/MEC community, or to only build a partial architecture will eventually undermine the efforts of those already in place.

5. Institutionalize Revitalization

As the change process begins to mature, it should slowly become part of the new organizational culture. The benefits of the change should become apparent, along with any problems that exist. The KM team can use these benefits to reinforce the participation

in knowledge management. The KM system can continue being refined to create better performance and remove identified flaws, or inconsistent behavior.

The knowledge sharing culture within the Coast Guard, or the HEC/MEC community may take a long period of time to change. Pervasive change can only take place as new people are indoctrinated into the ways of sharing knowledge, and resistors are transferred or retire. Leaders must continue to articulate the benefits of knowledge sharing, and reward those who participate.

D. SUMMARY

The limits identified with the current knowledge practices (e.g., cultural barriers, limited communities of practice, restricted awareness of resources, and limited access), can be overcome with the proper KM architecture. This architecture, founded upon the fundamental technologies of collaborative messaging and a complete CGDN, can be implemented through a series of modules. Each module addresses a separate problem within the KM system, and provides a solution using extant technology. Implementing such a system can be done on local levels, to build momentum for spreading the changes throughout the organization. Regardless of where the change starts, whether at a local level within a sub-community, or community-wide, it should require strong leadership and a powerful vision to succeed.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The major contribution this thesis provides is the development of a knowledge management architecture (KMA), using extant technology to improve the ability of the Coast Guard to capture and reuse informal knowledge. The focus was on applying this KMA to the high and medium endurance cutter (HEC/MEC) community and forming a knowledge base capable of expanding to encompass future business process reengineering efforts. Each of the limits exposed within the community's existing practices is addressed by the new KMA.

The design of the KMA allows existing communications capabilities to expand both formally (e.g., video conferences, team meetings, scheduled chat sessions), and informally (e.g., community discussion boards, ad hoc teams, and e-mail/intranet access). This allows for greater access to existing knowledge sources through indexing and categorization with knowledge mapping tools. The expansion of the Coast Guard Data Network (CGDN) may increase the opportunities for all members of the HEC/MEC community to engage in knowledge activities. Finally, the KMA provides avenues for overcoming existing cultural barriers to the use of knowledge management within the community.

To summarize, the methodology begins by examining the primary knowledge management practices in use within the HEC/MEC community. Strengths and shortfalls

are identified and discussed for each practice. After reviewing all practices, four primary limitations are examined. The modules of the KMA are adaptable to many scenarios, and are suitable for addressing the limitations of the existing knowledge practices. The last section of the methodology discusses, in general terms, the process for implementing the changes necessary to deploy such an architecture in the HEC/MEC community.

The technology necessary to implement the KMA is discussed for each module. It is found that technology exists to implement all of the modules. The most difficult part of the KMA to build will be a reliable link for underway cutters to the CGDN. This is expected to be the largest technical obstacle to full implementation. The next largest hurdle will be the cultural changes required to move the Coast Guard toward maximizing its knowledge management potential.

B. RECOMMENDATIONS

Based upon the conclusions above, recommendations are provided to establish the foundation for implementing a knowledge management architecture within the HEC/MEC community. The recommendations entail building the technical framework, conducting business process reviews, forming a KM team, and laying the groundwork for a cultural shift.

The most important technical recommendation is the overhaul of the Coast Guard's Data Network (CGDN). The establishment of a network operations center (NOC) and improved management facilitates reorganizing the network and regaining control of how it is used. Expanding the network to include ships at sea requires

significant research and development. This may need to be developed within the framework of the existing Deepwater Project, which is developing a future system of ships, aircraft and technology to replace aging members of the HEC/MEC community. The improved CGDN forms the foundation of any information technology program the Coast Guard develops, regardless of community.

The recommendation for conducting business process reviews (BPR) supports the effort to develop a sense of urgency for implementing the KMA. Explicit facts and figures illustrating the need for improved knowledge management may build support for the project. These figures may be used when seeking future budgets to develop the system. The BPRs may be used later when seeking pilot programs to build short-term wins during the deployment phase of the KMA.

Formation of a knowledge management team to lead the change is recommended to help establish the groundwork for building the vision and developing the plan for the KMA. Assembling leaders in the afloat and technology communities with the respect and capabilities to get the project through the initial stages is important for its success. Selecting personnel with operational and technical backgrounds for advanced schooling in knowledge management practices and techniques may provide a valuable cadre of available leaders later in the KM change process.

The final recommendation is promising from the knowledge management perspective. Building the culture necessary to foster knowledge creation and sharing may result in long-term benefits regardless of the technology or architecture in place. Coast

Guard personnel are bright, intellectually curious individuals ready for challenges. Reinforcing the value of knowledge management and encouraging participation from all levels of the organization may lead to immediate and long-term benefits. Not only can the Coast Guard benefit from the use and capture of more knowledge, but individuals may also gain a greater appreciation for why decisions are made, and feel empowered by their contributions to those decisions.

The greatest challenge to implementing an effective knowledge management architecture within the cutter community is the culture and its willingness to accept the changes required to eliminate the barriers to the smooth flow of ideas, experience, and knowledge. This system may affect a broad range of processes, procedures, systems, and people. Overcoming the fears associated with change requires strong leadership, and commitment to a knowledge management strategy.

C. FUTURE RESEARCH

The knowledge management architecture proposed here is robust enough to be used throughout all communities within the Coast Guard. These communities may share many of the same limitations and characteristics of the HEC/MEC community; however, each has its own unique limitations. Exploring these unique limits and examining how the modules of the KMA apply to them may yield further applications for the architecture.

Additional research in the area of intelligent software agents may add strength to the KM system. These tools could not only increase functionality in the portals and search module, but improve other areas of knowledge and information transfer. Many

possibilities exist for using intelligent agents, including supply chain management, personnel management, and maintenance applications. The opportunity to automate many of these processes, particularly in the cutter community could lead to increased compliance rates combined with reductions in manpower requirements.

Expert systems are currently being developed by the U.S. Navy to assist in troubleshooting complex equipment such as the MK-92 Gun Fire Control System (GFCS). Cooperative research into adapting experts systems such as these for Coast Guard use could yield savings in development and equipment troubleshooting costs.

Research into development of distance education technologies for use onboard Coast Guard cutters and isolated units is an area that is ripe for investigation. Online training and testing processes could be used to increase access to knowledge, reduce distribution costs, improve security and reduce administrative processing times.

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   Naval Postgraduate School
   Monterey, CA 93943

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   Washington DC 20593-0001

7. Commandant (G-SRF) 1
   2100 Second Street SW
   Washington DC 20593-0001

8. LCDR Andrew J. Sorenson 1
   5808 Windowpane CT
   Waldorf, MD 20603